POWER

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Business Is Business

It is a pleasure to realize that there are some fine, high type purchasing agents in industry—men who sense the present tendency to destruction of selling morale but who steadfastly refuse to capitalize it. They realize too well the interdependence of business relations and know that business can not long exist without profitable orders.

Of the many large purchasers I have talked to recently, not one but openly states willingness to pay a proper price for what he buys. The trouble, they say, lies nearly always in the practical certainty that among the sellers there will be at least one who breaks the field with an offer which leads to one of two conclusions. Either all the other bidders are little better than highwaymen or the low man should be safely tucked away in some padded cell where he can do no harm to himself or others.

But do not forget, the sellers have their shining examples of what a buyer can do when he is not actuated by high ideals. Some buyers simply must have their pound of flesh and never close a contract without forcing some seller to cut the price. Such tactics are calculated to make selling a game of wits and not the means of exchange on the basis of true value, upon which sound business prosperity depends.

EDITORIALS

The Swope Plan For Stabilization

During the past few months many industrial leaders have been heard on the depression and unemployment. Few have ventured beyond generalities and economic analyses. In view of this the suggestions offered by Gerard Swope, before the National Electrical Manufacturers' Association, command more than passing attention. Not only does he offer a definite plan, worked out in detail, but his views on unemployment insurance, pensions and other employee relations represent advanced thinking of a kind seldom publicly proclaimed by industrial executives.

Mr. Swope believes that industry must solve the problem without waiting for society to act through legislation. Through the medium of closer trade association cooperation he would stabilize production and insure to the employee the accrued benefits of employment within the industry. Some modification of present restrictions as to trade association activities would be necessary and the employee interest would be guarded by governmental supervision.

The plan is revolutionary in the sense that it represents a new approach to our economic and social problems at a time when the old formulas have proved inadequate to cope with the situation. Its value lies in the fact that a definite program has been offered by a man of Mr. Swope's standing, out of the discussion of which something tangible may result.

The Merit System Discarded

Announcement that the N.A.P.E. will discontinue the merit system which for some years has featured its educational program will be received not so much with surprise as with regret. It represented a creditable effort to carry out one of the fundamental aims of the association, namely, education; but unfortunately it was taken seriously by too small a group of the membership.

The association will revert to the plan of local educational work under the guidance of a national steering committee and members will be urged to take advantage of night schools and other local educational facilities.

The merit system had its inception in 1923 in the State of Michigan under the sponsorship of Garrett Burgess, then vice-president and later president of the national association. Adoption by the national body followed its success locally. Briefly stated, the system covered a prescribed course of study with examinations which, if passed, entitled the student to a "Certificate of Merit" that was accepted by many local chambers of commerce and industrial groups. Differing from an engineer's license, which represents minimum requirements to guard the safety of the community, it was in effect a guarantee of competence, in which employers had learned to place confidence.

While present conditions may have hastened withdrawal of support, those responsible for directing the N.A.P.E. seem to have given the system a fair trial and financial support out of proportion to the returns. The experiment is just one more indication that educational work is not popular with the membership at large despite individual declarations and the preamble to the constitution. This view is supported by the unpopularity of technical papers at state and national meetings and the difficulties encountered by educational committees of local associations.

One reason advanced is that the average age of the membership is over forty, after which a man is supposed to be less receptive to study. But what of the young man who is ambitious for advancement and must be prepared to meet the more exacting demands of the near future in which the economics of operation will receive prime consideration? Upon him rests the future of the operating group. Must he strive to achieve his aims unaided by his fellow engineers?

The Southwest Power Conference

This is the name given to the gathering in Kansas City Sept. 7 to 11.

The power interests of the United States have probably never before been brought together so completely and in such full representation of all technical phases of the industry.

Thirteen organizations participated, including eight national engineering or technical societies, the Kansas State Association of Municipal Utilities, the local Engineers' Club and Southwest coal interests. The meetings were well attended by seriously minded men from all parts of the country, and opinion is unanimous upon the accrued benefits, professional and social.

If spirit and optimism coupled with singleness of purpose and abiding faith in the future of our country are factors in the return to normalcy, the Southwest Power Conference has beyond question added a tremendous impetus to the burial of the depression.

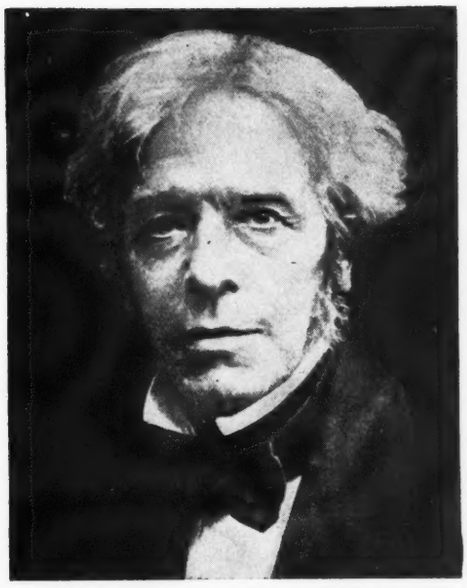
It may yet be recognized that the initiative of the people of Kansas City has made an outstanding contribution to the better days ahead.

Certainly the power interests of the country owe them a lasting debt of thanks for their splendid accomplishment, the influence of which will long be felt by their brother engineers.

▼

POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason



SCIENCE PAYS TRIBUTE TO

MICHAEL FARADAY

As far as humanity is concerned, "Convert magnetism into electricity" is probably the most significant entry ever made in a laboratory notebook. Michael Faraday made such a notation in 1822. Nine years later, on Aug. 29, 1831, he unlocked the secret with his discovery of the basic principles of electromagnetic induction, thereby paving the way for today's myriad uses of electricity

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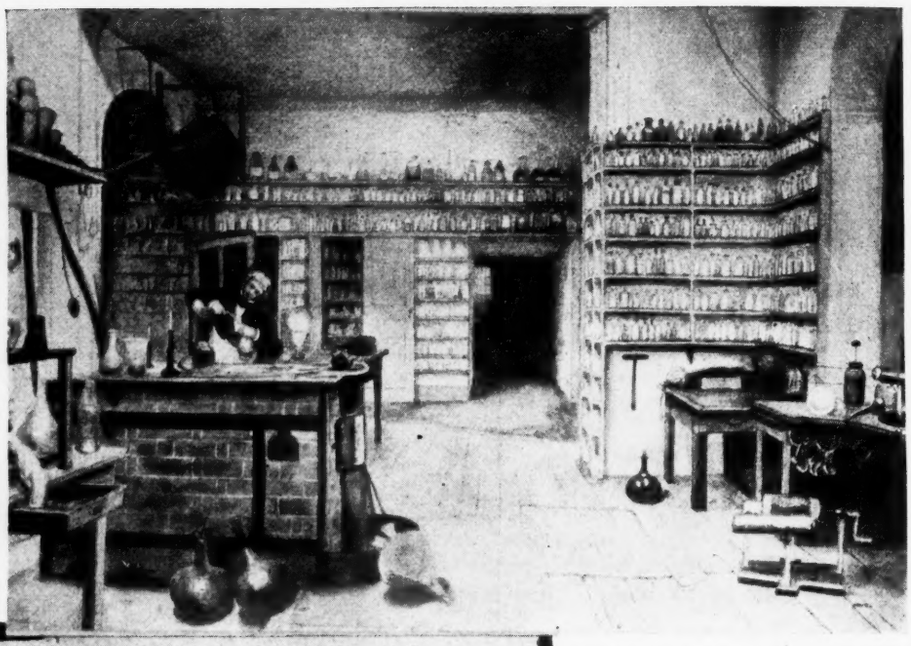
THIS WEEK members of 30 scientific and engineering societies, led by the Royal Institution of Great Britain and the Institution of Electric Engineers, will gather in London to participate in the Faraday celebrations commemorating the 100th anniversary of the discovery of electromagnetic induction. Tribute in the form of addresses by prominent individuals and a public historical exhibition of his work will be paid to the memory of Michael Faraday, whose invention of the dynamo has perhaps done more to increase the wealth of the world than any other scientific achievement. It may not be amiss, therefore, to review the life and career of this great "natural philosopher," as he was known.

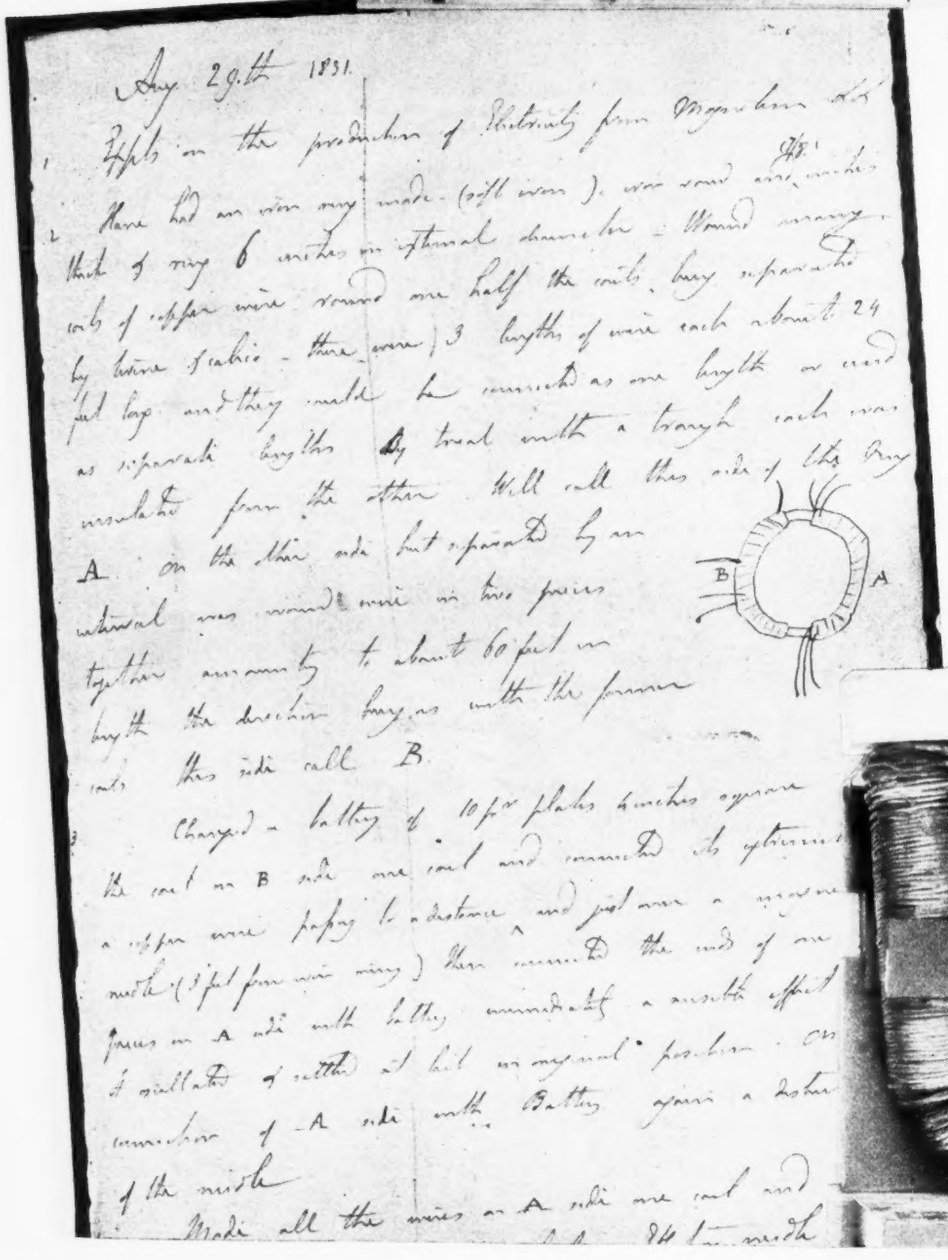
Michael Faraday was born on Sept. 22, 1791, in a little Surrey cottage. His father, a poor blacksmith, died when Michael was nine years old, leaving the family in straitened circumstances. Michael was put to work as an errand boy in a bookbinder's shop at the age of thirteen, and a year later he was apprenticed as a bookbinder. Despite his early hardships, he managed to acquire a rudimentary education—consisting, as he once said, of little more than reading, writing and arithmetic—and he took full advantage of the opportunities offered in the bookbinding shop to add to his store of knowledge. Permitted by his indulgent employer, Riebau, to read after hours the books he bound, Michael studied all of the articles on electricity in the "Encyclopedia Britannica," Watts' book "On the Mind," and Mrs. Marcet's "Conversations in Chemistry." He also attended lectures on natural philosophy given by a Mr. Tatum before a group known as the City Philosophical Society.

By this time Faraday had acquired a serious interest in science, not because, as he afterward wrote, he was "a very deep thinker, or was marked as a precocious person," but because facts were important to him. "I could trust a fact," he continued, "and always cross-examined an assertion." So when one of the bookbinder's customers took him to hear four lectures of the noted scientist, Sir Humphrey Davy, he made careful notes and sent them, as evidence of good faith, to Sir Joseph Banks, president of the Royal Society, with a request that he be given an opportunity to enter the "service of science." The attempt failed, however, and



Faraday at work in his laboratory in the Royal Institution of Great Britain, from a drawing in the possession of the society

A page from Faraday's laboratory notebook, on which he recorded the results of his historic experiment on electromagnetic induction



Aug 29th 1831.

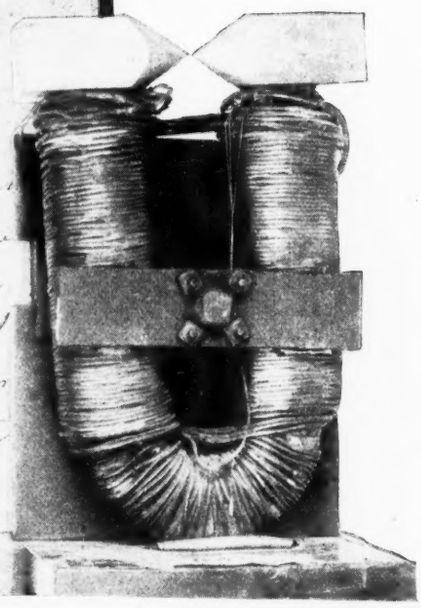
Experiments on the production of Electricity from Magnetism

I have had an iron ring made - (soft iron) - iron round and, which
thick & ring 6 inches in external diameter - Wound round
coils of copper wire round one half the coils being separate
by twine & calico - there were 3 lengths of wire each about 24
feet long and they could be connected as one length or used
as separate lengths - Each length was coated with a varnish which
insulated from the other - Will call this side of the Ring
A - on the other side but separated by an
external iron wound wire in two pieces
together amounting to about 60 feet in
length the direction being as with the former
coils this side call B.

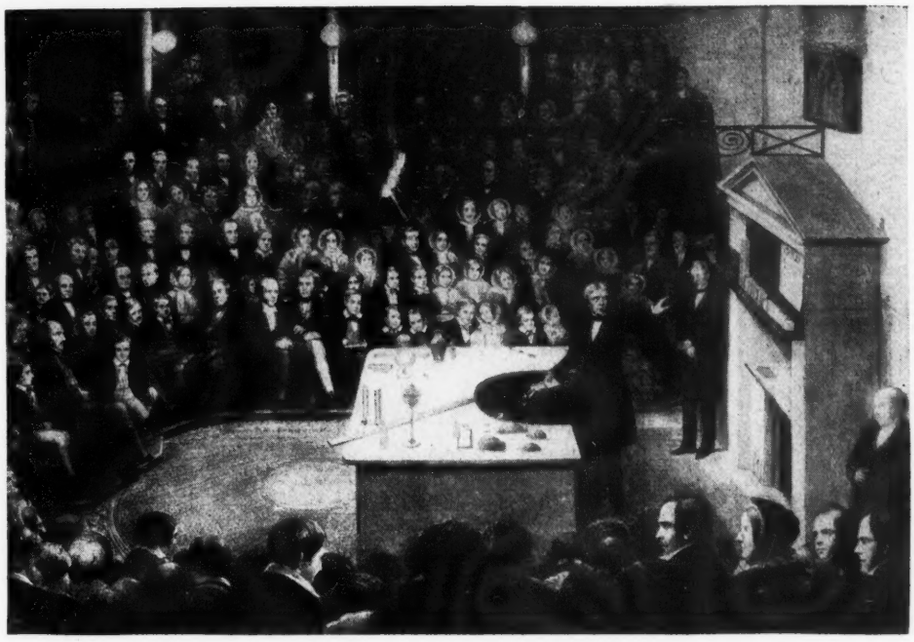
Charged a battery of 10 pr plates 4 inches square
the coil on B side was used and connected to galvanometer
a copper wire passing to a distance and just over a magnetic
needle (3 feet from wire ring) then immediately the end of one
piece on A side with battery immediately a sensible effect
& oscillation of needle & but on original position - On
connection of A side with Battery gave a deflection
of the needle

Made all the wires on A side one coil and

Original electromagnet constructed by Faraday for his experiments. It is now on exhibition in the Royal Institution in London



All photographs © William E. Gray, London



Faraday lecturing in London. The Prince Consort may be seen at the extreme left, facing the speaker

he did not try again until the fall of 1812, after he had entered the employ of another bookbinder, who was entirely unsympathetic to his scientific ambitions. Of this second attempt he wrote:

"My desire to escape from trade, which I thought vicious and selfish, and to enter into the service of science, which I imagined made its pursuers amiable and liberal, induced me at last to take the bold and simple step of writing to Sir H. Davy, expressing my wishes, and a hope that, if the opportunity came in his way, he would favor my views; at the same time, I sent the notes I had taken of his lectures."

Davy replied that he was "far from displeased" with the ability and interest shown in Faraday's notes, and promised him an interview as soon as it was convenient. Early in 1813 Davy asked Faraday to call and told him about a position, then vacant, as assistant in the laboratory of the Royal Institution. Faraday's immediate acceptance marked the beginning of one of the most brilliant careers in the history of science.

Among his first duties in the "service science," Faraday had to act as Davy's valet on a tour of Europe. Sir Humphrey's regular servant refused to make the trip, so Faraday was drafted on short notice to fill the place. Though Lady Davy insisted on treating Faraday as a domestic, Sir Humphrey and the Continental scientists ignored social distinctions and gave him every possible opportunity to join them in pursuing their common interest.

On his return from Europe, Faraday busied himself with the routine of the laboratory and conducted some experiments in chemistry on his own. He soon began to publish papers and give lectures on the results of his investigations, at the same time building up a small practice as a consulting scientist. The latter together with his appointment as superintendent of the laboratory improved his financial status to such an extent that he was able to marry in 1821. By this time he had acquired quite a reputation as a scientist, and in 1824 he was elected a Fellow of the Royal Society over the objections of Sir Humphrey Davy, then president of the society, who had become openly jealous of the success of his young protégé.

Always interested in electrical phenomena, Faraday made his first experiments on electromagnetic induction in 1821. He was intrigued by Oersted's discovery that an electric current possessed magnetic properties, and he became convinced that magnetism could be converted into electricity. So determined was he to discover the secret that it is said he used to carry a small electromagnet around in his vest pocket, which he would take out at every opportunity and contemplate with untiring interest.

In 1830 he decided to give up his consulting practice and all other outside activities, save one lectureship and his work at the Royal Institution and devote himself to the study of electromagnetism. One year later, on Aug. 29, 1831, his efforts were rewarded with the actual conversion of magnetism into electricity. His notebook entry of that date, shown on the opposite page, describes the historic experiment.

After further experiment Faraday actually constructed a laboratory model of the dynamo, forerunner of the modern electric generator. He never thought of obtaining a patent on his invention. So little was he concerned with material rewards that whenever any of his discoveries reached the patentable stage he immediately lost interest in them. Concerning the dynamo he wrote: "I have rather been desirous of discovering new facts and new relations dependent on magneto-electric induction than of exalting the force of those already obtained, being assured that the latter would find their full development hereafter."

Faraday's subsequent investigations led him into the fields of electrolysis and static electricity, where he succeeded in defining and classifying the fundamental laws of electro-chemistry and in establishing the identity of all the known electrical phenomena. At the same time he brought about a reform in terminology, replacing qualitative terms with units based on accurate laboratory measurements. His search for a relationship between light and magnetism led him to the discovery of the effect of a magnetic field on polarized light. Though Faraday's grasp of mathematics was limited to elementary algebra, his ideas on the nature of electricity, magnetism and light paved the way for James Clerk Maxwell to give mathematical formulation to the electro-magnetic theory of light, while his speculations on electrolytic phenomena foreshadowed the modern electronic theory.

Faraday gave himself so unstintingly to the "service of science" that in 1840 his health and memory failed him. After a four-year holiday he returned to his work and carried on for another eighteen years, when he lost his memory again. He died five years later, on Aug. 26, 1867, at the age of 76, and in keeping with the idealistic simplicity of his nature his funeral was private and unostentatious.

Costs at Grand Haven Diesel Plant

By C. A. HAMILTON
Hamilton & Weeber, Engineers
Grand Rapids, Mich.

Detailed construction and investment costs on 1,600-kw. municipal plant completed this year to replace an obsolete steam plant. The present operating cost, exclusive of fixed charges, is 7.36 mills per kilowatt-hour

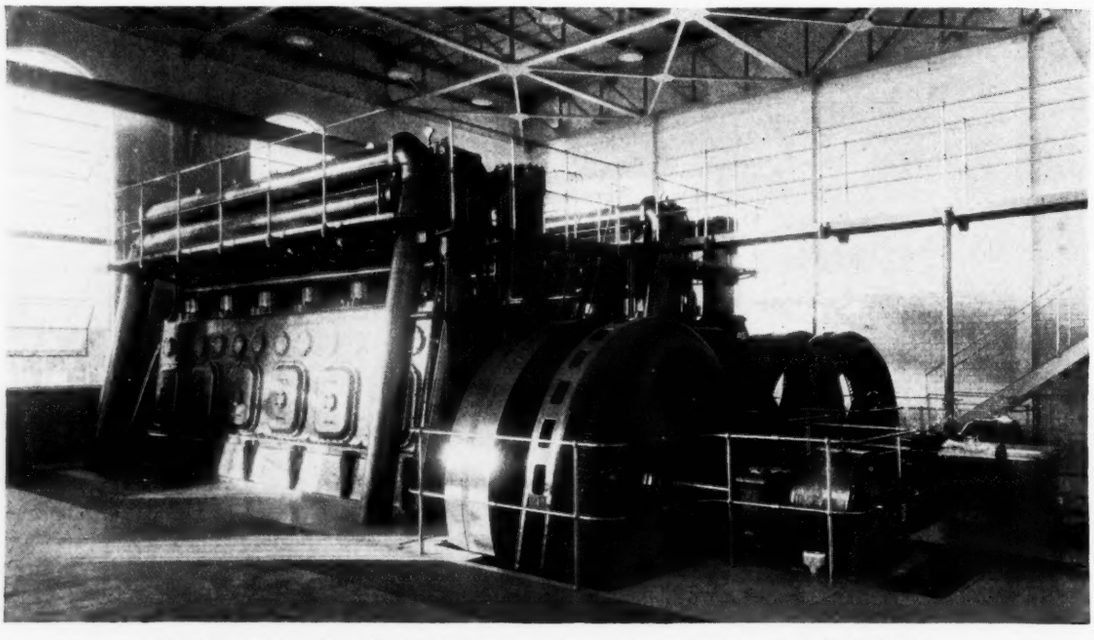
EARLY in 1929 the city officials in charge of Grand Haven's municipal electric business realized that the existing steam plant was becoming inadequate for the load and that production costs were high when compared with systems of similar characteristics. The City Commission therefore engaged the firm of Hamilton & Weeber to make an analysis of the power and lighting department, with particular reference to the generating station.

The report recommended the construction of an extension to the existing steam plant, to consist of a 1,500-kw. steam turbine with boiler and auxiliaries at an estimated cost of $237,550. As an alternate to this program the construction of an auxiliary diesel engine plant was proposed. This called for two 600-kw. units at an estimated cost of $178,000, with the future addition of a third unit of like capacity at a cost of $64,500, or a total of $242,500.

Sufficient funds were not available at the time to carry out either suggested program, as past earnings of the electric department had been diverted to the general city fund. Owing to the financial situation and the terms offered by the diesel engine builders the City Commission adopted the diesel engine program and on Dec. 3, 1929, we were engaged as engineers to proceed with plans and specifications for the station. On Dec. 23 bids were received on diesel engines and one week later our tabulation and recommendations were presented to the City Council. No action was taken by the Council at that meeting, and it developed shortly afterward that the private utility serving adjacent territory had entered into Grand Haven with the intention of acquiring the municipal electric property.

Plans for the station proceeded without the selection of an engine having been made until the middle of March, when the engineers were requested to suspend all work until after the election of April 7, 1930.

The power company in February, had offered to purchase the plant and distribution system. One offer was $1,200,000 for the property, a franchise, and the adoption of so-called state-wide rates in general use throughout the territory. The other offer was $1,400,000 for the property, a franchise, and the continuation of the



The two 800-kw. six-cylinder diesel generating units comprising the initial installation. Space has been provided for an eight-cylinder unit as the load increases

existing rates charged by the city. The necessary petitions were circulated and filed to bring the question, as required by law, before the people at the election. The vote on this proposition was 1,645 against to 919 in favor of selling the plant. At the same election it was voted to create a Board of Public Works. This consists of five industrial executives and business men chosen at large and serving without remuneration.

The board immediately began an exhaustive study of diesel engines throughout the United States, making a tour of Southern and Southwestern states where diesel plants are in operation. At this time the board had before it the proposals of the diesel engine builders received by the City Council the preceding December, and the engineers' partly completed plans and specifications for the station. As a result of this study, and considering that the financing of the diesel plant would be easier than an extension to the steam plant, the board decided to proceed with the construction of a new diesel plant to include two 800-kw. units instead of 600-kw. units as first contemplated.

In August the engineers were asked to complete plans and specifications, and revised bids on two 800-kw. diesel units were received from eight leading American manufacturers. These bids were carefully tabulated. It was decided to purchase two De La Vergne units with generators and exciters for $101,979 (approximately $63 per kilowatt). The revised estimated cost of con-

Details of Construction Costs, Diesel Engine Plant

BOARD OF PUBLIC WORKS, GRAND HAVEN, MICHIGAN

Hamilton & Weeber, Engineers, Grand Rapids, Mich.

	Material	Labor	Total
1. Building:			
Brick, concrete and steel construction, face-brick exterior with stone trim, 4,271.7 sq.ft Floor area 171,936 cu.ft. Contents including basement:			
Excavation	.....	$1,053.06	$1,053.06
Reinforcing steel	$1,015.49	.....	1,015.49
Concrete:			
Cement	1,575.24	.....	1,575.24
Gravel	573.91	.....	573.91
Form lumber	442.71	.....	442.71
Labor	.....	1,938.87	1,938.87
Huxman contract	4,272.48	.....	4,272.48
Equipment rental	67.71	.....	67.71
Miscellaneous	758.08	.....	758.08
Huxman contract—building above main floor line	23,121.40	.....	23,121.40
Plumbing	809.51	.....	809.51
Lighting system	1,562.99	557.93	2,120.92
Painting	356.54	.....	356.54
	$34,556.06	$3,549.86	$38,105.92
Building cost per sq.ft. $8.925			
Building cost per cu.ft. 0.2216			
(1,600 kw.) bldg. cost k.w. plant capacity—present.. 23.81			
(2,600 kw.) bldg. cost per k.w. plant capacity—future 14.65			
2. Diesel Engine Units and Foundations:			
Two—1140 b.h.p., 6-cylinder, 200-r.p.m. model VB, 4-cycle solid-injection, DeLaVergne engines with auxiliary compressed-air starting equipment, and two—800-kw. Elliott generators with two 17-kw. direct-connected exciters:			
Equipment contract	$101,979.00	.....	$101,979.00
Erection	1,520.02	$5,076.28	6,596.30
Foundations:			
Cement	1,131.21	.....	1,131.21
Gravel	897.66	.....	897.66
Form lumber	270.17	.....	270.17
Labor	.....	1,441.39	1,441.39
Equipment rental	280.51	.....	280.51
Pyrometers	547.96	.....	547.96
Insurance	350.00	.....	350.00
	$106,976.53	$6,517.67	$113,494.20
3. Switchboard and Station Power:			
Westinghouse contract	$10,123.96	$490.55	$10,614.51
Wiring to generators and exciters	1,601.52	324.63	1,926.15
Station auxiliary power lines	2,238.24	348.11	2,586.35
Brown Boveri voltage regulator	1,285.00	.....	1,285.00
	$15,248.72	$1,163.29	$16,412.01
4. Traveling crane:			
5-ton, 55-ft. span hand-operated Chisholm-Moore Co. (Crane erection incl. in Huxman building contract).	$1,681.38	.....	$1,681.38
5. Fuel Oil System:			
Graver tank works, 100,000 gal. steel storage tank, contract	$1,795.00	.....	$1,795.00
Excavation	.....	$2,059.60	2,059.60
Foundation and sidewalks	594.95	1,245.25	1,840.20
Piping	973.56	900.10	1,873.66
D-50 Hydroil purifier—contract	1,875.00	.....	1,875.00
50-g.p.m. fuel unloading pump	225.00	.....	225.00
King-Seeley tank gages	307.72	.....	307.72
	$5,771.23	$4,204.95	$9,976.18

	Material	Labor	Total
6. Lubricating Oil System:			
D-50 Hydroil purifier—contract	$1,875.00	.....	$1,875.00
Piping	254.92	$392.33	647.25
King-Seeley tank gages	135.72	.....	135.72
Two Griscom-Russell oil coolers	1,076.00	.....	1,076.00
	$3,341.64	$392.33	$3,733.97
7. Air Intake:			
Two Reed S.C.F. 6-unit air filters	612.50	.....	612.50
Piping	1,374.10	$197.45	1,571.55
	$1,986.60	$197.45	$2,184.05
8. Exhaust System:			
Two DeLaVergne 5-compartment mufflers	$835.00	.....	$835.00
Exhaust piping	1,221.62	$212.05	1,433.67
	$2,056.62	$212.05	$2,268.67
9. Cooling Water System:			
Intake and wells	$1,178.69	$1,654.21	$2,832.90
Equipment rental	138.38	.....	138.38
Elevated, 15,000 gal., steel storage tank on 50-ft. tower—contract	2,975.20	.....	2,975.20
Tank foundation	214.21	109.61	323.82
King-Seeley tank gage	139.65	.....	139.65
Pumps, one 400- and one 600-g.p.m. —contract	1,395.00	339.98	1,734.98
Piping and misc. material	1,074.53	.....	1,074.53
	$7,115.66	$2,103.80	$9,219.46
10. Building Heating Equipment:			
One American Blower Co. 3-30-F-4—916,000 b.t.u. unit heater	$523.43	.....	$523.43
Piping and office radiation	84.39	$193.30	277.69
	$607.82	$193.30	$801.12
11. Sub-station:			
One Delta-Star substation tower with bus and switching equipment	$2,056.54	.....	$2,056.54
Foundations	117.01	$193.29	310.30
Conductors and erection	1,572.27	957.22	2,529.49
Transformers, 2,000-k.va., 2,300-volt auto and one 833-k.va. 2,300/6,600-volt power	3,966.35	.....	3,966.35
	$7,742.17	$1,150.51	$8,892.68
12. Engineering:			
Hamilton & Weeber, design and consulting engineers	.....	$8,827.87	$8,827.87
Local inspections	.....	3.20	3.20
		$8,831.07	$8,831.07

SUMMARY

1. Building	$34,556.06	$3,549.86	$38,105.92
2. Diesel engine units and foundations	106,976.53	6,517.67	113,494.20
3. Switchboard and station power	15,248.72	1,163.29	16,412.01
4. Traveling crane	1,681.38	.....	1,681.38
5. Fuel oil system	5,771.23	4,204.95	9,976.18
6. Lubricating oil system	3,341.64	392.33	3,733.97
7. Air intake	1,986.60	197.45	2,184.05
8. Exhaust system	2,056.62	212.05	2,268.67
9. Cooling water system	7,115.66	2,103.80	9,219.46
10. Building heating equipment	607.82	193.30	801.12
11. Substation	7,742.17	1,150.51	8,892.68
Subtotal	$187,084.43	$19,685.21	$206,779.64
12. Engineering	.....	.....	8,831.07
Total construction cost	.....	.....	$215,610.71

struction for the station was $222,640 ($139 per kilowatt).

The existing municipal station was a rather ordinary steam plant, well situated for condensing water and coaling facilities. It contained five water-tube boilers, three turbines of 500, 1,000 and 1,500 kw. capacity and equipped with jet condensers. In 1929 the plant produced 6,434,300 kw.-hr. at an average operating cost of 1.3612c. per kilowatt-hour. In 1930 it produced 6,532,000 kw.-hr. at 1.2768c. per kilowatt-hour.

The new diesel plant was started in May, 1931, and has been carrying the entire load since, the steam plant carrying one banked boiler for a time until arrangements could be made for discontinuing the steam-operated fire whistle. In June, 1931, the diesel plant produced 452,200 kw.-hr. at a cost of $3,326.76, or an average of 0.736c. per kilowatt-hour. Of this amount $1,294.71 was for station salaries and labor, a part of which included men for years employed in the steam plant who have not yet been removed from the payroll. The ultimate reduction will reduce this labor charge about $450 per month, or about 1 mill per kilowatt-hour, making the resulting production costs about 6.4 mills.

PARTIAL LIST OF CONTRACTS

I. P. Morris and DeLaVergne—2 DeLaVergne engines and Elliott generators		$101,979.00
R. F. Huxman Building Contract—adjusted final		23,121.40
Manning Maxwell Moore-Chisholm Moore crane		1,666.00
Chicago Bridge & Iron Co.—15,000 gal. tank, 50-ft. tower		2,950.00
City of Holland—10-in. Elliott strainer—as is		100.00
Graver Tank & Mfg. Corp.—100,874 ga. fuel oil tank		1,795.00
Pelton Water Wheel Co.—400 and 600-g.p.m. cooling water pump		1,395.00
I. P. Morris & DeLaVergne:		
2-D50 Hydroil oil purifiers		3,750.00
1—50 g.p.m. fuel unloading pump		225.00
2—14-in. flexible exhaust connections		386.00
2—5-compartment DLV exhaust mufflers		835.00
2—SCF 6-unit "Reed" type air filters		610.00
1—Brown pyrometer		388.00
2—Griscom-Russell oil coolers		1,076.00
American Blower Co.—Unit heater		516.00
Westinghouse Elec. & Mfg. Co.—Switchboard		7,864.00
Westinghouse Elec. & Mfg. Co.—Gen. Cable Co. power cable		1,027.00
Maloney Elec. Co.—2,000-kva. auto tr. and 833-kva. 2,300/6,600 v.		3,541.00
Aelta Star Electric Co.—Substation		1,592.00
Kmerican Brown-Boveri Corp.—Voltage regulator equipment		1,285.00
Ding Seeley Corp.—Tank gages		575.50
Kellogg-Burlingame 1-in. centrifugal pump vs. 1-hp. motor		76.75
Crane Co. Piping G.H.P.O. No. 441 air intake piping	$1,331.80	
Exhaust piping	826.58	
Cooling water piping	747.81	
Fuel oil piping	257.98	
Fuel oil to storage tank	319.96	
Oil cooler piping	162.85	$3,646.98
Franz & Bailey—Unload and erection of Diesel engines at $9.00 per ton		2,568.00
Richards Mfg. Co.—Radiators, office and shower room		42.94

Since the 1930 operation with the steam plant showed a net income, after taxes and depreciation, of $49,943.84, it is expected that the savings in production costs of about 6.3 mills per kilowatt-hour produced will be applied to pay for the plant equipment. The total construction costs, including engineering fees, was $215,610.71.

In the selection of the diesel units the first question which came up in looking over the various proposals was the type of engine best suited to the local requirements. Fourteen bids were received on two-stroke-cycle and four-stroke-cycle, air-injection and solid-injection engines. The manufacturer's ability to produce a dependable piece of apparatus was a primary consideration rather than the type of engine. We finally narrowed the field to two manufacturers producing widely different types of engines, one a two-stroke-cycle, air-injection unit of the crosshead type, the other a four-stroke-cycle solid-injection trunk-piston type. In making our selection we were keeping in mind that continuity of operation was of major importance and we wished to eliminate if possible all chances of interruption caused by failure of auxiliary equipment as built into the unit for air-injection and two-stroke-cycle operation. Our observations of operating data, and the guaranteed fuel consumption of the various units offered, showed that the efficiency of the different types offered were so nearly the same that their difference could be neglected in making a selection. The engine chosen had the lowest rotative speed of any offered and the lowest mean effective pressure of the four-stroke-cycle group. Moreover, its price per kilowatt capacity was the lowest of all the engines offered.

After the engines were selected, alternate bids were offered on generator equipment by the leading manufacers. The discussion was based on the higher efficiency and rugged cast-iron frame construction of the generators and exciters selected.

The station was located adjacent to the old steam plant, near a sand dune. The soil is fine sand. Foundations extend down to about eight feet above the level of Lake Michigan. Each engine unit rests on its individual concrete foundation and is isolated from the building, no cork or other isolating material being used, however. The building is of concrete, brick, stone and steel construction.

There are two galleries. The first is level with the operating platform of the engines and accommodates the switchboard structure and the superintendent's office. The second has the fuel and lubricating-oil tanks and the storage battery for the solenoid-operated switches.

Electrical Equipment

The existing system was a two-phase, four-wire, 2,300-volt installation. A major portion of the industrial power was supplied through 2,300/6,600-volt step-up transformers located adjacent to the station. The power customers' installations were equally divided between straight two-phase, and two-phase- three-phase installations using Scott-connected transformers to give three-wire, three-phase supply on the secondary side. Inasmuch as two-phase distribution lacks many of the advantages of the three-phase, it was decided to make the diesel plant three-phase and operate it entirely as such.

At present the outgoing circuits are only two in number. One is to the 2,000-kva. auto-transformer bank at the new outdoor substation, by which means the two-phase steam plant bus and the three-phase diesel bus are tied together. The other is to a bank of three 833-kva. 2,300/6,600-volt power transformers. The old two-phase, 6,600-volt power circuit was extended back as a loop circuit. One end of this is to be cut and built into the three-phase bank. As the customers installations are changed to three-phase, the loop will be shortened on the two-phase leg and lengthened on the three-phase leg until the entire circuit is three-phase. As the existing 2,300-volt two-phase circuits are built over to three-phase, they will be transferred from the steam plant bus to the diesel bus.

All switching, instrument transformer and bus structure are located on the first gallery. Oil circuit-breakers are operated by remote control switches through solenoids. All instruments and signal lamps on the switchboard are illuminated from the storage battery system, making them independent of the main generators. The station lighting may be taken from either the diesel or steam plant bus, while the spare exciter is driven by a two-phase, 2,300-volt motor directly from the steam plant two-phase supply. The new switchboard is equipped with disconnecting switches for the complete isolation of all oil circuit breakers and current transformers.

The topography of the site is such that we were able

to bury a 100,000-gal. steel storage tank in a sand dune adjacent to the plant. The cost of this arrangement is slightly more than for placing the tank above ground and surrounding it with the necessary dike and protective features required by the fire underwriters. However, it has the advantages of being less unsightly, and of keeping the oil at a temperature above 48 deg., the ground temperature for this latitude. The maintenance on a dike in the fine sand would be an item requiring frequent attention. The tank is surrounded by a brick wall laid adjacent to the steel shell, to prevent collapse when the tank is nearly empty.

A 50-g.p.m. unloading pump delivers oil from tank cars to storage through a 3-in. line running through the basement. Paralleling this line is a $1\frac{1}{4}$ in. hot-water line with a coil in the storage tank. Hot water is obtained from the exhaust drop-leg water jacket and is circulated by a small motor-driven centrifugal pump. This hot water also heats the radiators in the locker room and the superintendent's office. The fuel oil is drawn from storage by an oil purifier, heated, centrifuged and pumped to the elevated 250-gal. day tanks on the upper gallery. Each engine has its own tank.

Lubricating-Oil System

The engine has what is known as a dry crankcase. A gear pump mounted integral with the main shaft pumps the oil from the engine base to an elevated 250-gal. rest tank on the second gallery. This tank receives the oil after it has been through an oil cooler, through which passes all the cooling water before it reaches the engine. An oil purifier is installed on the lubricating-oil system, a duplicate of that on the fuel oil, except as to bowl design, thus making the two machines interchangeable. The lubricating oil systems on each engine are separate and independent, except that the same purifier is used.

Raw River Water for Cooling

As this plant is near the main channel of Grand River where it enters Lake Michigan, it was possible to design almost any type of cooling-water system. After considerable study it was decided to pump raw river water through the engines in sufficient quantity to result in an outlet temperature low enough to prevent scale deposits. By keeping the outlet temperature below 120 deg. no scale is formed, and the economy performance of the engines has indicated that the relatively cold cooling water has no appreciable effect.

Because of the presence of fine sand in the air when the wind velocity is high, intake air to the engines is obtained through the spiral riveted intake pipes which draw the air from above the roof of the station. An expansion chamber at the basement level provides space for the six unit air filters which are installed on the ends of the intake pipes leading to the engine. By taking the air from the roof and using an expansion chamber and air filters, the air intakes furnish the engines with clean air without noise. Space was allowed for the installation of intake mufflers, but they were found to be entirely unnecessary with the system used. The intake expansion chamber is built into the building substructure and provides for the third engine installation.

Exhaust System

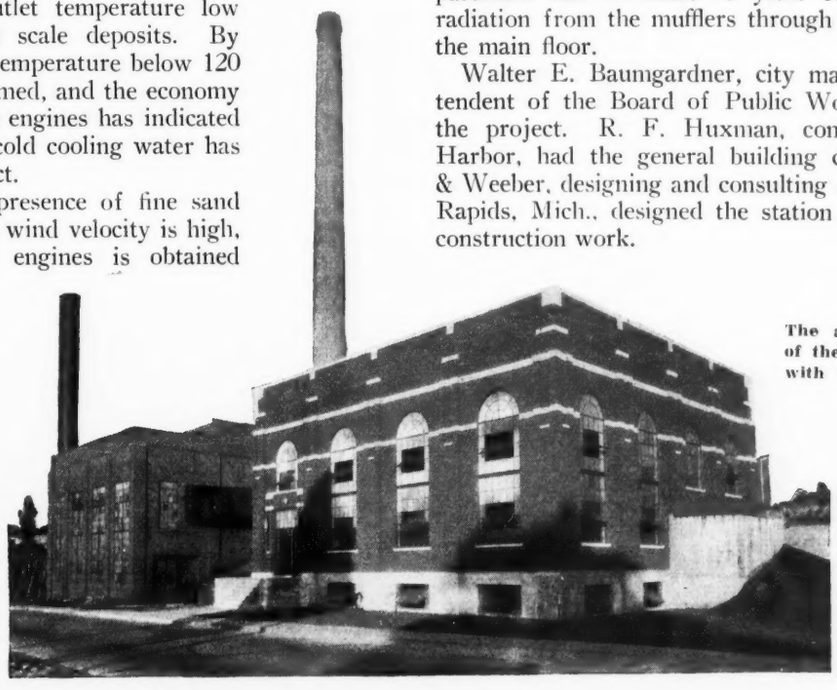
The engine exhaust lines are equipped with flexible connections to reduce expansion and vibration strains. Five compartment mufflers are installed on each unit. These are in a corner of the basement and instead of being covered with insulating material they are inclosed by an 8-in. brick wall. Summer ventilation is provided by opening the windows in the outside walls of the muffler chamber. If the heat radiated by the mufflers is required to warm the building, provision is made to install a fan and discharge the air through open grating into the main room of the station.

Some study was given to the installation of an exhaust-gas waste-heat boiler or heater for warming the building during the winter, but this was abandoned for the system used. Provision was made in the exhaust system piping for the future installations of the necessary three-way valves and connections if a heater is found desirable when the steam plant is ultimately retired.

Building Heating Requirements

In the latitude of Grand Haven the building will require heating for eight months, from Sept. 15 to May 15. Computations show that under average load conditions the generator heat losses, plus the surface radiation from the engines, will warm the building sufficiently for the comfort of the operator. The locker room and superintendent's office are heated by hot water radiation supplied from exhaust-leg water jackets as previously described. In severe weather the exhaust muffler compartment can be made to yield considerable heat as radiation from the mufflers through areas of grating in the main floor.

Walter E. Baumgardner, city manager and superintendent of the Board of Public Works, had charge of the project. R. F. Huxman, contractor, of Benton Harbor, had the general building contract. Hamilton & Weeber, designing and consulting engineers, of Grand Rapids, Mich., designed the station and supervised the construction work.



The architectural treatment of the new plant harmonizes with that of the old plant adjoining

The Compression of Liquid Water

The compressibility of water is no longer a matter of purely academic interest. Compressibility increases rapidly with temperature, so that the feed pumps in modern high-pressure stations consume a substantial amount of work in compressing the feed water

By ROBERT C. H. HECK

Professor of Mechanical Engineering
Rutgers College

UNTIL recently there has been a blank in our quantitative knowledge of the thermodynamic behavior of water. This has been in the subsaturation region of the liquid, or at temperatures lower than the boiling point under a given pressure. That blank is now filled, by Keenan's formulation of this portion of the American Steam Research, presented to the Society of Mechanical Engineers last December and published in *Mechanical Engineering* for February.

The formulation is made definite in a condensed table, of the same terms as the superheat table giving specific volume v, total heat h and entropy s along lines of constant pressure and in columns of constant temperature. Using that table, the purpose of this article is to discuss the isothermal and adiabatic compression of liquid water, leading to a simple answer to two practical questions. These are:

1. Starting with water at 32 deg. F., but under a high pressure p, how much heat will be required to bring it to the boiling point or saturation temperature under this same pressure?

2. Water enters a feed pump at pressure p_1 and temperature t_1; it is raised to p_1 and delivered into the boiler or a high-pressure heater; there, how much heat will be required to bring it to saturation temperature t_f or to some t_2 not quite so high?

The showing of Keenan's table and some derived results are made graphic in Figs. 1 and 2, by plots of v and of h on a vertical base of p, the last ranging up to 6,000 lb. abs. The primary curves are the full-line isotherms, rising from saturation curve FF and lettered AB at 600 deg. With them, and from the same starting points, are drawn curves AC of adiabatic or isentropic compression. Along an adiabatic the temperature rises, hence either v or h runs larger than along the isotherm.

At low temperatures the p-v isotherms are essentially straight lines, or compression is at a uniform rate. Along the 32-deg. isotherm the shrinkage is from 0.016021 cu.ft. at practically zero pressure to 0.015705 cu.ft. at 6,000 lb., or by 0.01972 of the initial volume. Then the modulus of volumetric elasticity is

$$6{,}000 \div 0.01972 = 304{,}000$$

For steel, changing to volume decrease instead of linear shortening as base, the corresponding number would be around 80,000,000.

As temperature rises the isothermal compressibility increases rapidly, taking on a variation in rate that has to be represented by a curve. Along a horizontal line of constant pressure the rate of expansion with respect to temperature increases rapidly, as shown by the wider and wider spacing of the isotherms.

Note in Fig. 2 how the lower isotherms slant to the right as they rise, showing an increase of h with p when t is constant. As temperature is higher this slant diminishes, disappearing at 500 deg. where the isotherm is vertical. About that temperature slant reverses, with

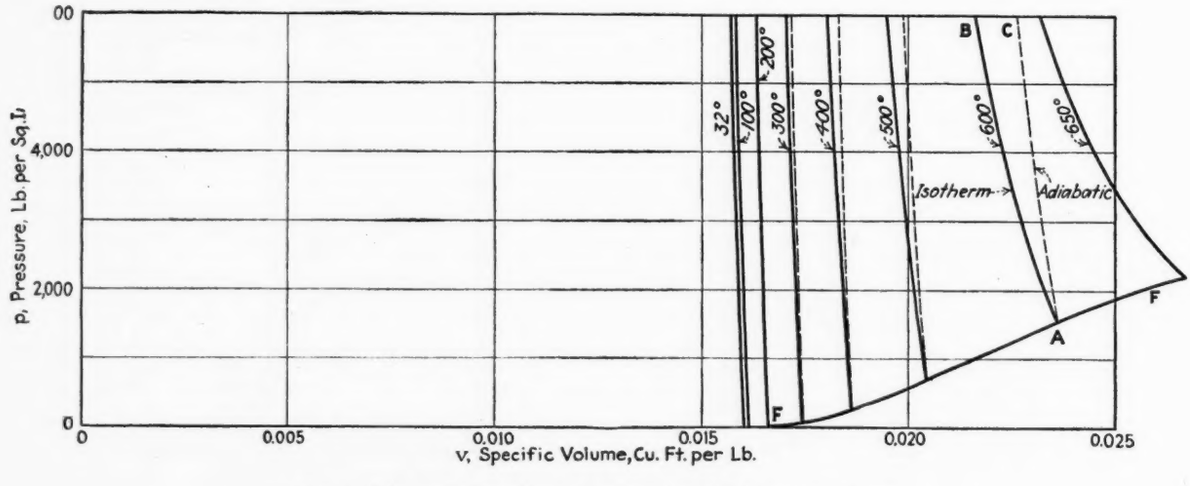


Fig. 1—The pressure-volume diagram for liquid water. From saturation line *FF* rise isotherms (full-line, directly from table) and adiabatics (dotted-line, computed for constant entropy)

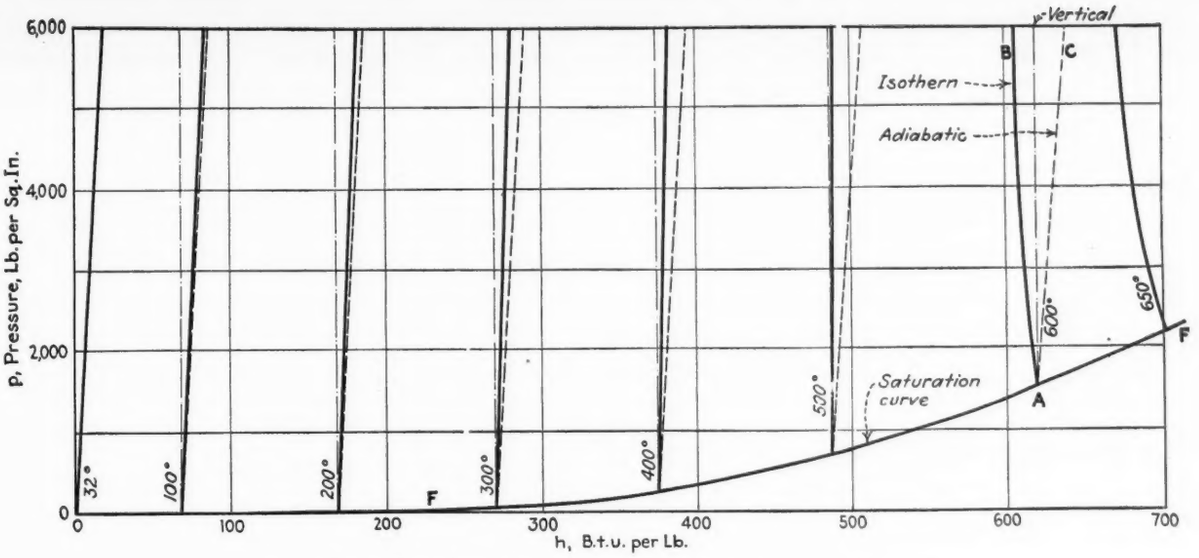


Fig. 2—The pressure-heat diagram for liquid water, with isotherms and adiabatics corresponding to those in Fig. 1. From each initial point on curve *FF* is drawn also a vertical dot-and-dash line, for comparison

increasing rapidity, toward the general trend of the curves for superheated steam.

At 32 deg. the *h-p* adiabatic is indistinguishable from the isotherm, the computed difference running inside of 0.2 B.t.u. But as temperature rises the adiabatics do not change in trend; they remain nearly parallel, but slant a little more to the right.

Comparative Isotherms

As a first step toward a full understanding of what happens in the compression of liquid water it will be well to go back and study comparatively the isothermal compression of superheated steam and of a "perfect" gas of the same general dimensions. Fig. 3 is drawn in true proportions for one pound of steam at 600 deg. F., starting at A with $p_1 = 60$ lb. abs. and $v_1 = 10.423$ cu.ft., and going to B where $p_2 = 600$ lb. and $v_2 = 0.9431$ cu.ft. During this isothermal compression product pv changes from 625.4 at A to 565.9 at B. Dotted gas curve AB' holds pv constant at the initial value.

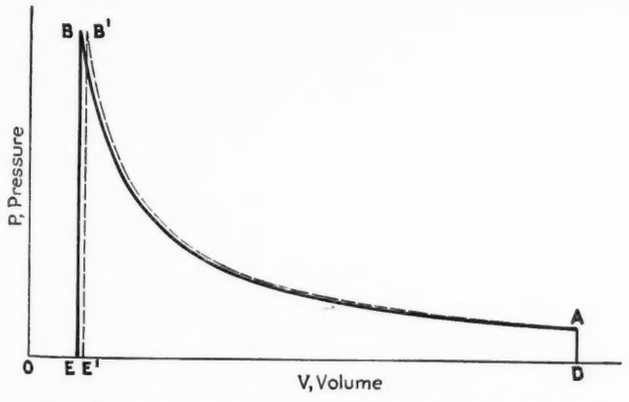


Fig. 3—Curves of isothermal compression: curve *AB* for superheated steam at 600 deg. from 60 lb. to 600 lb. abs.; curve *AB'* with *pv* constant and the same pressure range

Consider first the compression AB'. For the value of work area $DAB'E'$ in heat units,

$$AW = \frac{625.4}{5.4} \log_e 10 = 115.8 \times 2.303 = 266.7 \text{ B.t.u.}$$

Here $5.4 = 778/144$ is the divisor that converts a pv quantity into heat units when p is in pounds per square inch. The fact now to be emphasized is that just this work quantity is the heat that must be removed to keep temperature from rising.

With steam (curve AB) we cannot calculate work area $DABE$ directly. Instead, the first step is to get the heat q_{ab} as a product of entropy change by absolute temperature. This comes out 300.4 B.t.u., but it does not all represent work of compression. During operation AB the internal energy u of the steam is found to decrease by 31.0 B.t.u.; and when this is deducted from heat q the remainder, or 269.4 B.t.u., is the heat equivalent of the work done upon the steam in compressing it. The new fact is the change of internal energy, which in effect is squeezed out of the steam by raising its pressure at constant temperature. In compression of the liquid this change of energy becomes the predominant fact.

To continue the pressure ratio 10, take the water isotherm at 400 deg. F., with $p_1 = 247.3$ at saturation and $p_2 = 2{,}500$. By Keenan's new liquid table the entropy values and their difference are

$$s_2 - s_1 = 0.56059 - 0.56638 = -0.00579;$$

then with $T = 859.6$ the heat removed must be

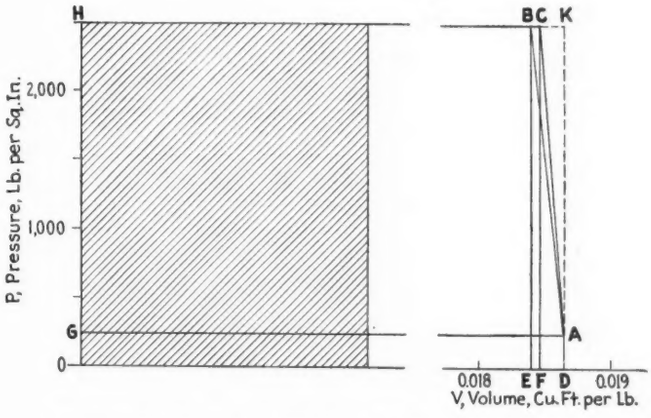


Fig. 4—Isothermal compression *AB* and adiabatic compression *AC* of one pound of water, at or near 400 deg. F., from saturation at *A* to 2,500 lb. pressure. Note the much enlarged horizontal scale, as compared with Fig. 1. The shaded rectangle represents one B.t.u.

$$q_{12} = -0.00579 \times 859.6 = -4.97 \text{ B.t.u.}$$

Internal energy comes by the operation

$$u = h - Apv = u - pv/5.4; \qquad (1)$$

then the internal energies and their difference compute thus:

p =	247.3	2,500
v =	0.018634	0.018391
h =	374.85	377.51
Apv =	0.85	8.51
u =	374.0	369.0

$$u_{12} = -5.000 \text{ B.t.u.}$$

That u_{12} comes out a trifle larger than q_{12}, instead of a trifle smaller, means that there is yet a slight residual inconsistency in the table. The work of compression must therefore be determined directly as the area under curve AB in Fig. 4. This curve is so nearly a straight line that for mean pressure we may use the average of p_1 and p_2, here 1,370 lb. per square inch. The volume difference DE is 0.000243 cu.ft.

The product of these two numbers is 0.332; then

Work of compression $= 0.332 \times 144 = 47.8$ ft.-lb.

Its heat value $= 0.332 \div 5.4 = 0.061$ B.t.u.

In this particular case the change of energy is about 75 times the external work of compression.

Adiabatic Temperature Rise

The reason is now clear why adiabatic compression of liquid raises its temperature, even though the work of compression is a very minute quantity. In order that temperature shall not rise, an appreciable amount of internal energy must be allowed to escape. If escape is not permitted this energy remains and causes the temperature to rise. The amount of such rise is shown comprehensively by Fig. 5. There the base line represents the saturation line of the liquid, as that appears in a column of the table for saturated steam. Any vertical is an adiabatic starting with an isotherm on this bottom scale; but the temperature of the adiabatic rises according to a scale graduated by the curve intersections. By the scale at the top of Fig. 5 the entropy value for any adiabatic is shown.

Comparative Curves

By diagrams having a magnified scale for changes of total heat h and internal energy u, two cases of the compression of water are fully shown in Fig. 6. In either case the value of heat of liquid h_f at point A on the saturation line is taken as the origin of measurement and is represented by vertical AK. Then four curves are plotted, as follows:

AB is the isotherm and AC the adiabatic of h, the same curves as in Fig. 2; AE is the isotherm and AG the adiabatic in u, each derived from its h curve by deducting Apv.

The important practical fact now made apparent is that internal energy u is nearly constant along the adiabatic of the liquid, with the consequence that increase of total heat h up the adiabatic is very nearly equal to the increase in quantity Apv. Exact equality is expressed by the formula

$$h = h_1 + A\,(p - p_1)\,v_1. \qquad (2)$$

Here subscript 1 designates quantities belonging to the initial or low-pressure point of an adiabatic expansion, while plain h is the total heat at some higher pressure p. In Fig. 6 this formula is represented by the dot-and-dash line AC', distinct from computed AC in the 400-deg. case.

The principle expressed by equation 2 has not had to wait for recognition until an accurate table of properties was developed for the liquid. Turning back to Fig. 4, we know that along adiabatic AC the value of u must increase by the equivalent of work area $DACF$, beneath the curve and between volumes. Similarly, from A to C the increase of h is equivalent to the work area $GACH$, to the left of the curve and between pressures. Equation 2 assumes this area to be a rectangle on GA or v_1 and GH or $p - p_1$.

If the table were perfectly consistent there would be a departure from equation 2 just equal to area ACK, greater as the adiabatic was near to a higher isotherm. Fig. 6 shows an excessive decrease of AC from AC' in

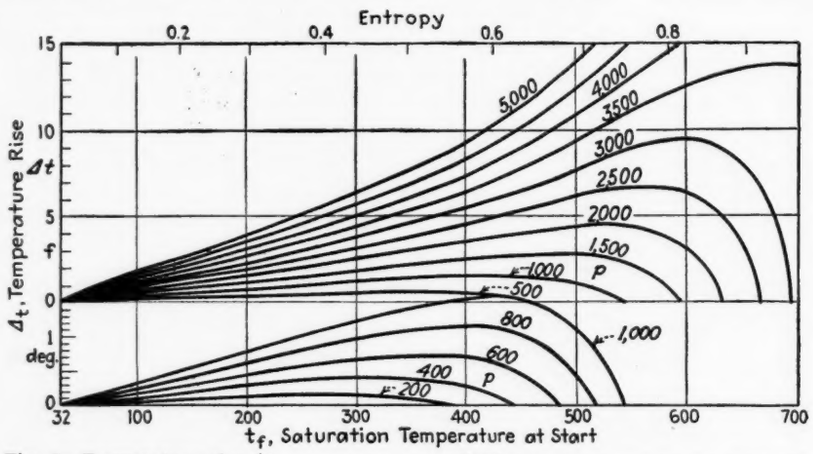


Fig. 5—Temperature rise Δt during the adiabatic compression of liquid water

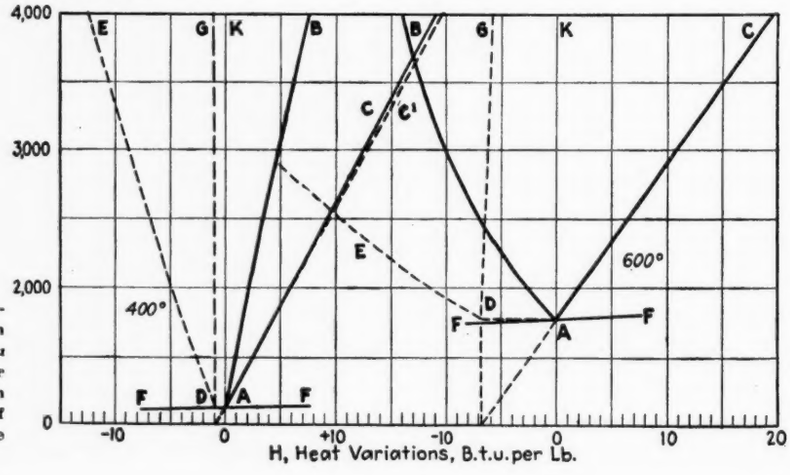


Fig. 6—Two sets of isotherms and adiabatics in total heat h and energy u for liquid water. To a large horizontal scale are shown departures from the heat of liquid at point A on the saturation line of water

the 400-deg. case and an absence of real decrease in the 600-deg. case; but it is apparent that the whole discrepancy is a minor fraction of one B.t.u.

Equation 2 really answers both of the questions stated at the beginning of this article. Feed-pump action is essentially an adiabatic compression *AC*, Fig. 4, preceded by low-pressure intake *GA* and followed by high-pressure expulsion *CH*. This fact brings question two under the formula; and the further fact that at 32 deg. the isotherm is practically identical with the adiabatic makes the formula answer question one also.

With a feed supply at atmospheric pressure and at the temperature in the usual range, the work of the feed pump is approximately

$$AW_p = 0.003\,p, \qquad (3)$$

measured in heat units. Exactly, the constant 0.003 comes from $v_1 = 0.0162$, through division by 5.4; and at high temperatures of open feed heating, approaching 212 deg., this coefficient will evidently run small.

With high pressure and temperature of pump intake, as in a regenerative or turbine-bleeding system, the real use of the liquid table is to give values of h_1 and of v_1 at a subsaturation temperature. After that, the simple calculation by equation 2 is amply accurate for all practical purposes to give the value of h at which high-pressure heat impartation begins.

▼

Cause of Overheating on an Instrument Transformer

FAILURE in the auto-transformer on a large synchronous condenser made it necessary to tap the condenser rigidly into the main generator buses and bring the turbine-generator and condenser up to speed as a single unit, and upon reaching speed to throw the condenser from starting to running. That arrangement was used until a new auto-transformer was installed.

After all arragements had been completed the turbine was started. While the turbine was still far below speed the odor of hot insulation was detected. At the switchboard it was found that the "running" and "incoming" synchronizing plugs were in. Also, thick smoke was pouring from back of the switchboard. The plugs was pulled out immediately, but an instrument transformer on that circuit was already on fire.

The plugs had been put in by the superintendent's assistant before the machines were started and this was apparently the cause of the transformer's overheating.

▼

SEVERAL laboratories are trying the bend test for determining the elastic properties of alloys at temperatures up to 1,000 deg C. The permanent change in curvature produced by heating metal strips to various temperatures while constrained to known curvatures has been determined. It has been shown that the proportional limit as determined by the tension test at room temperature corresponds to the sharp bend in the permanent bending curve at the same temperature.

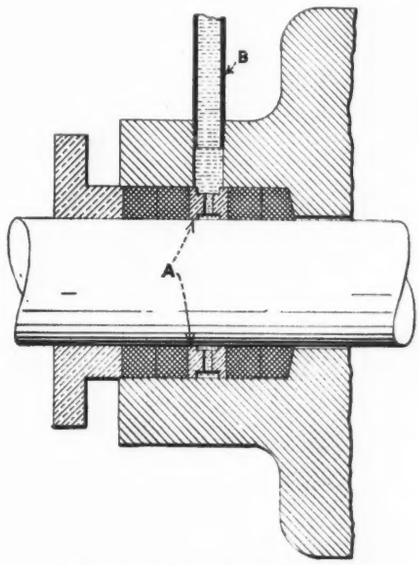
This test has been developed under the direction of Howard Scott, Westinghouse research engineer, and was described in a paper "High Temperature Charactristics of Metals Revealed by Bending" presented at the 1931 meeting of the A.S.T.M. in Chicago.

Packing Centrifugal Pumps

By G. B. LONGSTREET

TWO CIRCUMSTANCES stand out as the causes of stuffing box leaks; and one is greatly influenced by the other. Badly worn shaft sleeves contribute the greatest number of leaks. Improperly packed glands give much trouble and are the cause of much shaft-sleeve wearing. The word "improperly" might apply to several wrong practices, I use it only as descriptive of those conditions where the correct size and proper material of packing is used but wrongly installed.

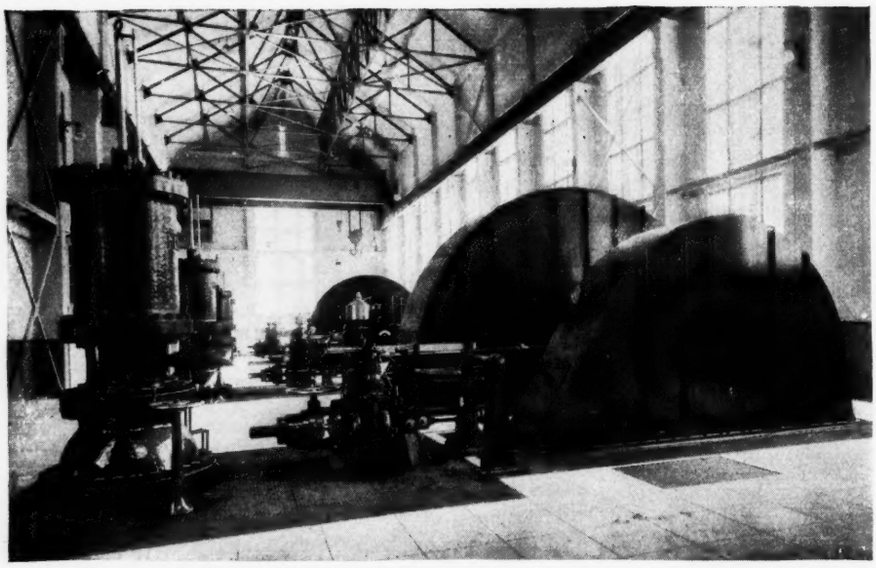
The stuffing box of a centrifugal pump is a continuous cavity around the shaft, but inserted into it circumferentially is a metal gland often called the lantern. This is of a size to fit snugly into the box with a good clearance around the shaft and split diametrically to facilitate placing it. Holes are cast or drilled through it diametrically so that fluid can be fed through it, onto and around the shaft. The function of the lantern is to receive fluid from the discharge side of the pump, through the pipe or channel that connects the discharge side with the stuffing box, usually about halfway of its length, and distribute it around the shaft as a seal and lubricant.



Cross-section of stuffing box

The figure shows a typical arrangement of packing in a stuffing box with the lantern gland *A* in its proper place. *B* is the pipe connecting with the pump discharge chamber. Too often in placing the packing the lantern is put too far back, either it does not connect with the fluid supply line at all, or is closed off soon after as the packing wears and is squeezed tighter. Such a condition leaves several rings of packing running without a seal or lubricant. These circumstances cause rapid wear of the packing, spoiling the packing sleeve and furthering leakage. The lantern should be set a little outside of central when compared with the position of the fluid supply line. This will give ample room for a connection with the latter after the packing has been compressed.

When starting a pump the first time after packing, prime it if possible and get water through this supply line to the packing. Do not screw the packing down hard. Let it leak at first, then gradually take it up where it belongs



Two 36,000-hp. double - overhung impulse wheels in Tiger-Creek plant operate under an effective head of 1,190 feet

Initial Mokelumne Development Goes into Service

The Pacific Gas & Electric Company recently put into service on the Mokelumne River two hydro-electric plants with a total installed capacity of 85,000 hp. The Tiger Creek station has two 36,000-hp. units operating under an effective head of 1,190 feet

CONSERVATION of water from the Sierra Nevada streams in Northern California for hydro-electric purposes was materially advanced during 1931, when the Pacific Gas & Electric Company completed its Salt Springs dam. This dam creates an artificial lake extending nine miles up the Mokelumne River canyon and impounds 130,000 acre-ft. of water. Two new hydro plants, Salt Springs and Tiger Creek, which utilize the waters from this reservoir, were formally dedicated to service in July.

Salt Springs and Tiger Creek power houses, with a total installed capacity of 85,000 hp., are the initial units of a chain of four plants which the company plans to install on the Mokelumne River. A six-year construction program including an expenditure of approximately $40,000,000 was started in the fall of 1928 and calls for the completion of all four power houses, with a combined capacity of 228,000 hp., by the end of 1934 (see *Power*, May 27, 1930, page 842).

Salt Springs dam is in the canyon of the North Fork of the Mokelumne River about 50 miles east of Jackson. Construction work on the dam, employing a daily average of 1,000 men, was started in 1929 and completed in April, 1931. The dam is of the rockfill type and rises 328 ft. above stream bed, with a crest length of 1,300 ft. It is 900 ft. thick at its base and has a cubic content of 3,000,000 cu.yd. of rock taken from cliffs adjacent to the damsite. This dam is the largest of its type in the world. A spillway capable of discharging 48,000 cu.ft. per second is channelled in the south side of the gorge adjacent to the dam.

The outlet works at the north end of the dam consist of two 10-ft.-diameter steel pipes inserted into the downstream end of a 19-ft.-diameter concrete-lined tunnel. This tunnel was built originally to divert the flow during dam construction. Each of the pipes is provided with a 10-ft. 9-in. diameter hydraulic-operated butterfly valve, and extends into the river channel to end in a 78-in.-diameter butterfly valve designed for free discharge. These are emergency valves and will clear the reservoir at the rate of 10,000 acre-ft. per day.

From one of these pipes a branch forms the 8-ft.-diameter penstock to the generating unit installed in Salt Springs power house, which is a few hundred feet

downstream from the dam. From the other pipe a branch ends in a 54-in. needle valve with an energy absorber of the through-baffle type and discharges into Salt Springs power house tailrace. This bypass line supplies water to the Tiger Creek conduit, which heads in the tailrace, when Salt Springs power house is shut down or operating under reduced head.

Bear River is one of the principal tributaries of the North Fork of the Mokelumne River, following a generally precipitous course to form a confluence with the Mokelumne about six miles below Salt Springs dam. The stream is at a considerably higher altitude than Salt Springs dam, and the fall in the last six miles above the junction with the Mokelumne is more than 2,500 ft. The program calls for construction of a dam about 200 ft. high in Bear River some 2.5 miles below the existing dam, which now forms Upper Bear River reservoir. This reservoir will have a capacity of 34,000 acre-ft. A tunnel approximately two and one-half miles long will end in a penstock which leads to Salt Springs power house. The junction of the penstock and tunnel is formed in a surge chamber to be excavated in the rock. The elevation of the top of this surge chamber is above high water in Lower Bear River reservoir.

Water from Cold Creek, a stream similar in character to Bear River but lacking storage sites, will be diverted into this surge chamber, providing for storage in Bear River reservoir of the runoff from the territory above the diversion point on Cold Creek. Water diverted from Cold Creek will be partly used through the power house and partly backed up through the pressure tunnel for storage in Bear River reservoir. Any spill from these sources may be stored in Salt Springs reservoir.

The water from Salt Springs reservoir is under a variable head, depending upon storage behind the dam. The maximum static head is 244.5 ft., and the turbine driving the generator is designed to pass 550 sec.-ft. at heads as low as 175 ft. The turbine is rated at 13,500 hp. power and 300 r.p.m., and the generator is rated 11,000 kva., 11,000 volts, 60 cycles, 85 per cent power factor.

A decided contrast with the Salt Springs installation will be had with the unit installed to utilize water from Bear River reservoir. This unit will have a static head of 2,089 ft. The waterwheel will be a single overhung impulse unit capable of developing about 35,000 hp. at 300 r.p.m. The generator will probably be rated 30,000 kva., 11,000 volts, 60 cycles, 85 per cent power factor.

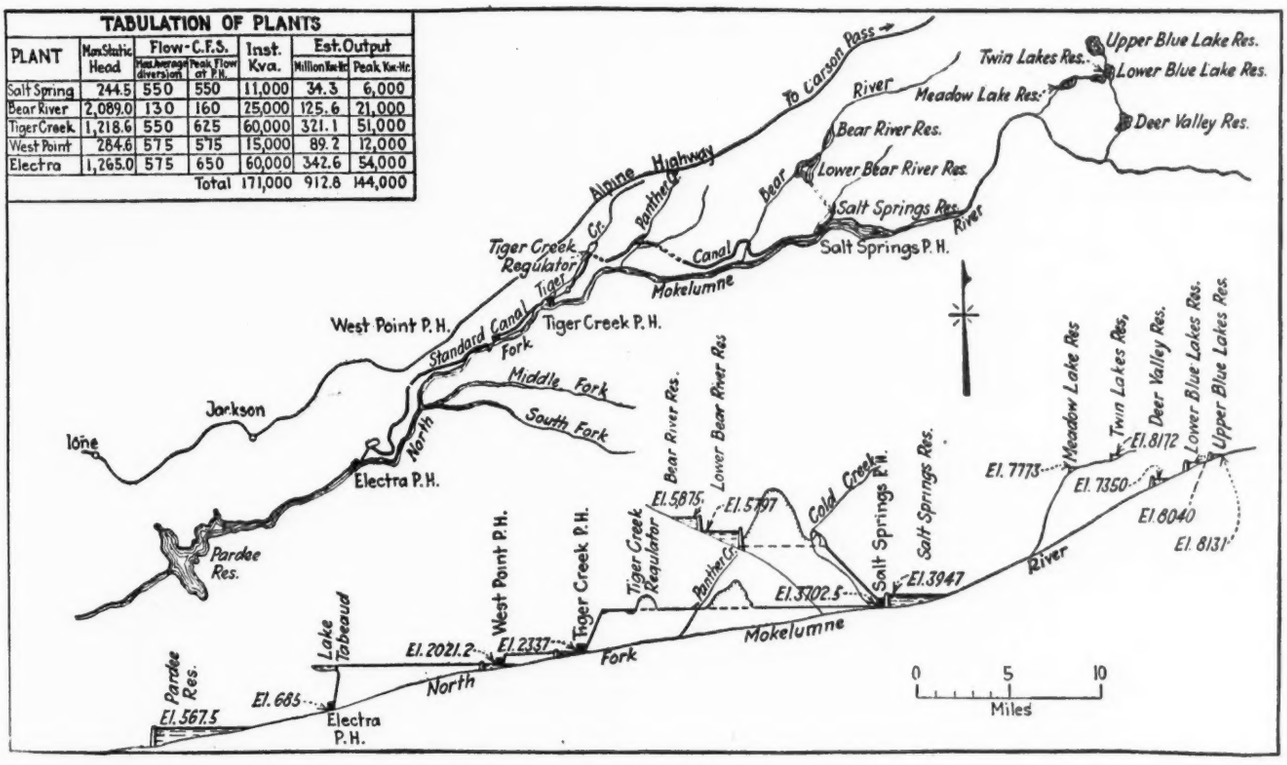
Both units will discharge into the tailrace which supplies water to the Tiger Creek conduit. This makes possible a constant flow in the conduit, with a widely varying kilowatt output from the power house, as may best suit the load requirements of the system.

The low-tension switching arrangement in the plant is simple. Each generator is connected to a main bus through a single truck-type oil circuit breaker. Two additional truck-type breakers feed power from the main bus into the station power transformer bank. The breakers supplying the station transformers are interchangeable with the main generator breakers. While this required extra large breakers for the service demands, the added cost was greatly offset by the simplicity of the arrangement and the possibility of taking any oil circuit breaker out of service for inspection or repairs without any loss in plant output. Power from this plant is stepped up to 110,000 volts and fed through a single-circuit line to the main 220,000-volt step-up transformer banks at Tiger Creek power house.

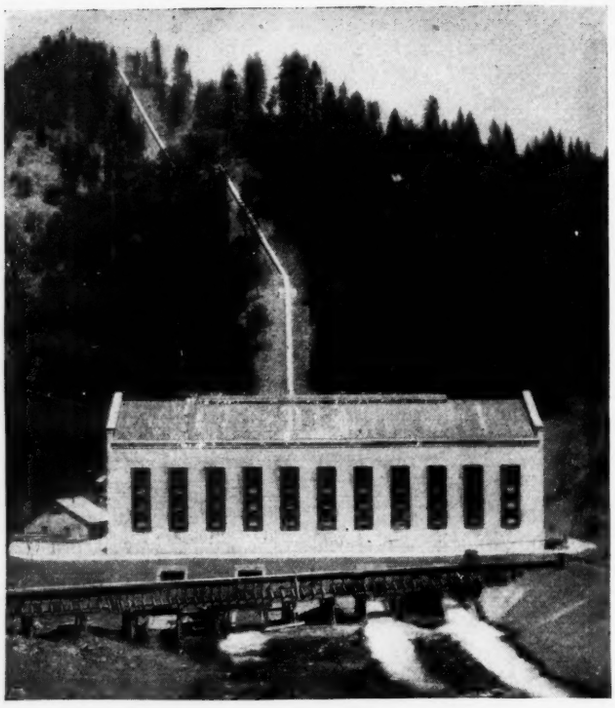
Water discharged from Salt Springs power house is diverted from the tailrace into tiger creek conduit. The capacity of the conduit is 550 sec.-ft. It is 17.3 miles long, terminating in a regulating reservoir on Tiger Creek. An additional conduit from the regulating reservoir of 625 sec.-ft. capacity extends 2.6 miles to a fore-

TABULATION OF PLANTS

PLANT	Max. Static Head	Flow - C.F.S. Max. Average diversion	Flow - C.F.S. Peak Flow at P.H.	Inst. Kva.	Est. Output Million Kw-Hr.	Est. Output Peak Kw-Hr.
Salt Spring	244.5	550	550	11,000	34.3	6,000
Bear River	2,089.0	130	160	25,000	125.6	21,000
Tiger Creek	1,218.6	550	625	60,000	321.1	51,000
West Point	284.6	575	575	15,000	89.2	12,000
Electra	1,265.0	575	650	60,000	342.6	54,000
			Total	171,000	912.8	144,000



The five plants in the Mokelumne project will utilize a total head of 5,100 ft. and have an installed capacity of 215,000 horsepower



Penstock to Tiger Creek plant is 4,750 ft. long, varying from 102 in. in diameter at the top to 72 in. at the "Y" outside the plant

bay at the head of the penstock leading to Tiger Creek power house.

This flow conduit is composed chiefly of a reinforced-concrete bench-type of flume, although parts of it are elevated. It has a water section of 84 sq.ft. and a water depth of 6 ft. The grade of the portion from the intake to the regulator is 0.8 ft. per 1,000, and the grade of that portion between the regulator and forebay is 1 ft. per 1,000. Two steel siphons are included in the circuit, each 93 in. in diameter with a total length of 0.23 miles, and there are also 2.5 miles of unlined tunnel with a section 10 ft. wide by 11.3 ft. high on a grade of 3.5 ft. per 1,000 feet.

Tiger Creek regulating reservoir is formed by a buttressed slab concrete dam approximately 100 ft. high, located on Tiger Creek. The upper 18 ft. of the reservoir provides about 175 acre-ft. of capacity. This is sufficient to permit peaking the Tiger Creek plant for 20 hr. each day, when full diversion is being made at the head of Tiger Creek conduit.

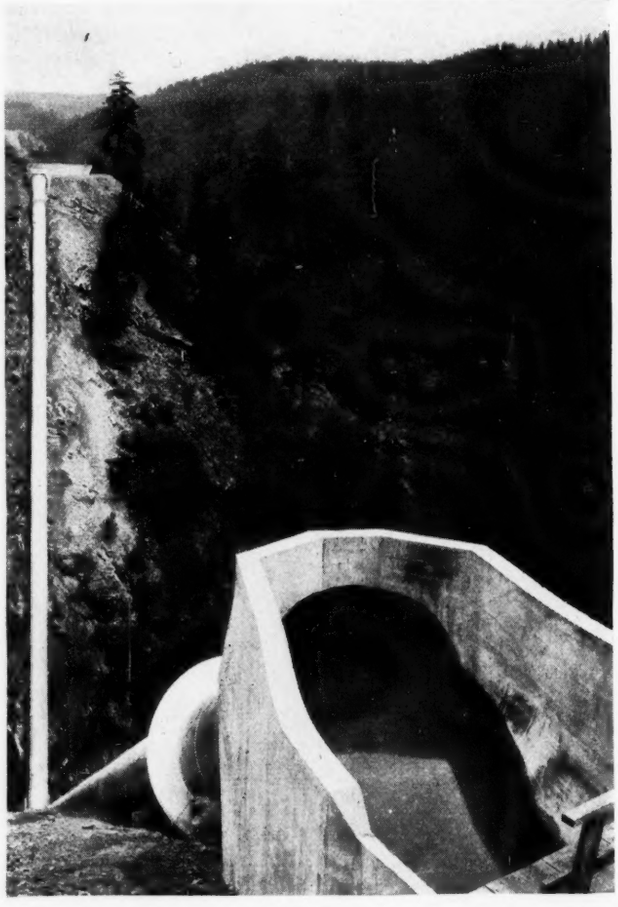
At the site of Tiger Creek power house no natural forebay sites were available, necessitating excavating a forebay with a capacity of 40 acre-ft. More than 200,000 cu.ft. of material was removed in the construction of this forebay.

The penstock leading from the forebay to the power house consists of a single steel pipe 4,750 ft. long, varying in diameter from 102 in. at the top to 72 in. at the "Y" outside the power house. Approximately 4,000 ft. of the upper portion of the penstock is of riveted steel with the rivets countersunk; the lower section is of seamless pipe. At the "Y" the penstock branches into two 52-in.-diameter lines and again into four 36-in. lines, a separate line leading to each of the four impulse wheels of the two double-overhung units in the power house.

The Tiger Creek plant is the controlling station for the 220,000-volt transmission lines which lead into the interconnected pool. About 25,000 kva. is required to charge each of these lines, which fixed the minimum generator capacity for single-unit charging at that figure. Each waterwheel unit was designed to deliver 36,000 hp. at 225 r.p.m. under an effective head of 1,190 ft., each of the overhung impulse wheels being rated at 18,000 hp. The generator rating is 30,000 kva., 11,000 volts, 60 cycles, 85 per cent power factor.

The Pelton waterwheel units installed at Tiger Creek are among the largest impulse wheels ever constructed. Many refinements have been incorporated in their design. A straight-flow needle nozzle introduces a minimum disturbance in the water flow, giving a uniform jet delivering maximum power to the waterwheel buckets. The power needles operated by the governor servomotors are arranged for slow closure upon load rejection, as a water conservation measure. Linked with the governor and needle operating mechanism is a jet deflector, or stream bender, in the form of a collar surrounding the jet, which operates to remove water from the wheel instantly upon load rejection. The combination of jet deflector and slow closing needle is ideal for an impulse wheel installation, as the water can quickly be diverted from the wheel without disturbing the flow of water in the penstock, with its attendant surge. This permits economies in the installation through reduced penstock cost and the omission of a surge chamber.

Each generator, with its associated step-up transformer bank, is considered as a unit, and there is no oil circuit breaker between the generator and the low-voltage side of the transformer. A steel bus structure containing four 11,000-volt truck-type oil circuit breakers is installed in a bus room. Two of the oil circuit breakers serve to connect the generators to an 11,000-volt bus



Deer Creek syphon on the Salt Spring to Tiger Creek conduit

for the purpose of synchronizing before closing the main 220-kv. breakers. When the units are in parallel on the high side of the transformers, one of these breakers is opened, separating the units on the generator side, the other remaining closed to supply power for station requirements. The remaining two truck-type breakers are for the station power transformer bank. As in the case at Salt Springs power house, these station power oil circuit breakers are made interchangeable with the main breakers, thus providing spare oil circuit breaker equipment.

Each generator is provided with a direct-connected exciter and pilot exciter controlled by voltage regulators. A spare exciter set installed between the main generating units is driven either by an impulse waterwheel or an induction motor. Each waterwheel has its individual governor oil pressure system with duplicate oil pumps. One pump is motor-driven, the other driven by a small impulse wheel. For normal operation the motor-driven pump maintains the oil pressure, but suitable controls have been provided so that any failure of supply from the motor-driven pump will automatically start the water-wheel driven pump to maintain the governor oil pressure.

The step-up transformers consist of two main banks with one spare unit arranged for physical interchange in case of damage to an operating unit. These transformers are provided with combined two-winding and auto-transformer windings. The auto-transformer winding has a rating of 10,000 kva. per unit and will step the incoming power from Salt Springs power house from 107,500 volts to 215,000. The tertiary winding has a rating of 10,000 kva. per unit, giving 30,000 kva. per bank, sufficient to care for one Tiger Creek generator. The transformer banks will thus have a capacity of 60,000 kva. each, 30,000 kva. for one Tiger Creek unit and 30,000 kva. from Salt Springs. Each bank is capable of carrying the normal Salt Springs output as well as the output from one Tiger Creek unit.

An afterbay to re-regulate the water discharged from the Tiger Creek plant was constructed about two miles below the power house. A concrete arch dam about 100 ft. high was built, creating a reservoir with a flooded area of some 100 acres. The top three feet of this reservoir, with a capacity of 300 acre-ft., will be used to regulate the Tiger Creek peaks as well as some of the irregularities of the natural runoff tributary to the lower plant which are not controlled by the storage on the system.

Salt Springs power house and Tiger Creek power house were formally dedicated on July 11th and 12th, 1931, and are now in active service. Construction of the Bear River project, West Point and Electra will be taken up as service demand warrants.

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The Paradox of Coal Prices

Since 1925 mine prices have declined 25 to 59 per cent yet the delivered decline amounts to only 10 to 18 per cent, since freight costs more than coal at the mine. Finally, the total decline in coal cost is less than the saving that can be made by intelligent selection of the coals offered

By G. B. GOULD
President
Fuel Engineering Co. of New York

FOR several years now the industrial buyer of coal has been favored with what is called a "buyers' market," which means that instead of having to exert himself to find a sufficient supply he is besieged continuously by eager sellers. And prices of bituminous coal have been declining steadily until they are now lower than at any time since before the war.

This long continued period of declining prices, keen competition and uninterrupted supply is apt to create, rather naturally, a false sense of security, and to make it seem that accurate discrimination as to coal values is both less important and easier than ever before. It is just human nature under such circumstances to relax one's vigilance in appraising values when a commodity seems so plentiful and prices are all the time getting lower. And this is especially so in the case of a commodity like coal, the value of which is not readily apparent but must be determined by careful investigation.

A comparison between actual prices for bituminous coals of like quality in 1925 and 1931 reveals the fact that during this period, in which prices have declined to a point disastrously low from the standpoint of the coal producer, (from 25 per cent to 50 per cent at the mines for those classes of coal used in large-scale steam generation), the effect on steam costs has been very much less than the conditions themselves would lead one to believe. In fact the whole decline during the six-year period, expressed in terms of its effect on steam costs, is much less than these costs are affected by factors always present within each plant.

To measure the decline in prices, a comparison was made between the actual prices quoted to our clients on about one hundred different coals during the first six months of 1925 and quotations on the same number of coals made during the first half of 1931, on those sizes and types of coal which represent the bulk of the tonnage being used for steam generation. Five groups of coals were used in this comparison: (1) New River and Pocahontas run-of-mine (at New England ports); (2) low-volatile coals from eastern Pennsylvania and Maryland; (3) high-volatile run-of mine from western Pennsylvania; (4) high-volatile slack from Pennsylvania and northern West Virginia; (5) southern Illinois slack.

The average decline in price between 1925 and 1931 for each of these groups but one is almost exactly 2c.

per million B.t.u. The Eastern high-volatile slack coals (group 4) have been particularly depressed in the price during the past winter, with the result that the decline in this group is 2.5c. per million B.t.u.[1] Roughly, 2c. per million B.t.u. is equivalent to 50c. a net ton of coal.

It is an interesting fact that, with the one exception noted, the decline expressed in terms of the cost of energy has been so uniform over such a wide range of coal fields and coal quality. But it is even more interesting to see just what the effect has been on the cost of energy at the point of coal consumption.

Because of the preponderant effect of freight charges this decline of 25 per cent to nearly 50 per cent in the cost of energy at the mine represents a decline of about 10 per cent for low-volatile coals in New England and most industrial centers in the Middle Atlantic section, and in the case of high-volatile slack from 12 per cent at central New England points to 18 per cent in western New York State. The decline in per cent of cost is greater, of course, at points nearest the mines. Likewise the decline in cost for southern Illinois slack at Chicago averages 12 per cent, and about 16 per cent at St. Louis.

These percentages represent the decline in coal cost which every industrial coal consumer should have experienced in this period of six years, without any improvement in coal selection, plant operation, or in plant equipment. Present costs should not be compared, however, with 1926 or 1927, during which years the long decline in prices was temporarily interrupted by a sharp rise resulting from the threat of a coal strike in 1927.

Cheap Coal Has Fostered Indiscriminate Selection

It is a curious fact, however, that industrial buyers of coal have been clearly conscious of this prolonged decline in bituminous prices, which amounts to 2c. per million B.t.u. over a period of six years, and have perhaps been lured by the apparent ease of coal buying into a too-complacent attitude toward the need of accurate discrimination, when there exist all the time differences in value, at any level of the market, amounting to more than twice this amount.

For example, in *Power* for April 7, the Eastern coal market was analyzed for the summer of 1930, and the 76 coals then used for comparison showed a spread of 5.1c. per million B.t.u., from a high of 19.1c. to a low of 14.0c. at a typical destination. Not quite a year later the coals available in the same area, and used for the comparison now being made between 1925 and 1931, show a spread of 5.0c., from 18.2c. to 13.2c., while in 1925 the range was 5.1c., the high being 20.3c. and the low 15.2c.

In other words, a long continued "buyers' market" like this one easily tends to create an economic illusion of cheap coal getting steadily cheaper, and easy to buy, which diverts attention from opportunities for economy that exist all the time, at any general level of prices, and which are actually twice as important, in dollars, as the whole decline in the general level of coal prices over a period of six years. Slowly declining costs in any department are seldom a spur to greater effort, and no doubt contribute to an unearned sense of satisfaction on the part of industrial executives, who are not personally familiar with coal-market values in detail. This, in turn, may unconsciously cause them to defer consideration of various methods of reducing steam costs, either by improving methods or equipment, opportunities for which would only be disclosed by careful investigation.

And by the same token steam costs which have remained stationary, or have increased, during this period raise a strong presumption of a declining standard of performance. The continually shifting values in the coal market make it impossible to appraise accurately the performance of a steam plant, including the whole process from coal selection to delivered steam, unless carefully related to coal-market values at the time. Steam costs which are merely related to past performance in a given plant give no indication as to whether the best economic performance of that plant has been reached. Unless related to changes in coal-market values, declining costs may give a false sense of improvement, rising costs may be unduly alarming, and stationary costs may conceal either improving performance or a slipping back.

[1] In making this comparison the average quality of each coal was tabulated, and the price decline figured in cents per million B.t.u. to avoid any possible distortion due to a choice of coals differing in value in the two periods, and to put the comparisons between districts on the same energy basis. Actually, the quality averages for each group showed no significant difference between the two periods.

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Motor-Installation Rules Simplify Maintenance

By MARIN PHILLIPS

IT IS just as important that equipment be correctly installed as it is that it be given proper attention in operation. By giving proper attention to the installation of electrical motors and control the maintenance problem is simplified. Unless machinery is installed so that it can be inspected without the attendants taking undue hazards, they can hardly be blamed for being neglectful. To the end that all motors and control equipment will be installed to the best interests of operation, written instructions are given to the construction men in one large plant.

These instructions cover all the important features necessary to install the motors and controls so that they can be maintained with a minimum of effort and to insure that the equipment has been properly put into service. The instructions also eliminate the old excuse of the construction crew that it was not known certain things were required in the work. When the construction men are given written instructions and are held responsible for complying with them a higher standard of workmanship is obtained. The instructions for installing motors and control equipment in the plant previously referred to are as follows:

See that setscrews are tight in motor pulleys.

Install pulleys so that short or flush end of hub is toward the bearing.

Install the baseplate so that the belt-tightening screw will be on the side of motor opposite to that of the leads.

See that oil-reservoir gages are on the side of bearing opposite to that of the direction of belt pull.

Thoroughly tighten oil-reservoir drain plugs.

Inspect oil rings to see that they are turning.

Watch the bearings for one-half hour after starting motor to see that they do not overheat. When doing this, raise oil well cover cap and feel the bearing shell.

Paint all taped connections and the inside of switch and starter boxes with insulating varnish. All iron-

work, racks, brackets, and outside of control equipment is to be painted with iron paint.

Test all wiring with megohm meter before applying power. All new wiring and equipment should test 100 megohms to ground. All old equipment operating at 600 volts or less should test at least 5 megohms to ground.

Check for correct connections in the control or starting equipment before applying the power. Inspect the inside of any rotating equipment to see that no foreign objects are present.

All bolted electrical connections are to have a lock washer under the nut or head of screw in bus work or on terminal blocks.

All 440-volt line switches are to have arc barriers.

Provide an insulated platform in front of all control equipment for 440 volts and higher.

Tape all connections before trying rotation of motor.

Before moving a motor draw the oil out of the bearings, to prevent spilling it on the winding.

Return all used oil to the oil house for refiltering for use in lineshaft bearings.

In case of an old motor, flush out the bearing and thoroughly clean the oil-reservoir gages.

Where wiring bends sharply, or rests heavily on bushings in switch and junction boxes, or control equipment cabinets, it should be protected with fish paper or empire cloth.

The job should not be considered completed until the motor, switch and control equipment frames are grounded, using approved ground clamps on a thoroughly cleaned grounded object.

Stencil line switch and control equipment with feeder number and mill number. Also, stencil on the name of drive or any other identifications necessary to make the equipment easily located in an emergency.

See that the motor is equipped with oil-reservoir covers and with a dust cap on the bearing away from the drive end of the shaft.

When installing small motor pulleys oil or grease the shaft and keyway. The key should have a good fit, but loose enough to be driven by light taps with a small hammer.

All motors are to be mounted on a firm foundation, raised high enough above the floor to protect them from water. Where cement bases are used place the anchor bolts for the motor's base in pipes large enough to allow side movement of the bolts. Level the motor and base on the foundation, using metal shims, and carefully align the pulleys. Tighten all bolts, put the belt on and tighten it sufficiently to carry the load. Run the motor and shift the base slightly if necessary to make the belt run true on the face of the pulleys. Finally, grout the base in, using cement with such consistency that it will settle well under the base and fill the foundation bolt pipes, to prevent the base from shifting.

When conduit is buried in a cement floor, red lead all couplings and screw them up as tight as possible. Give the conduit a coat of asphalt paint. When the conduit is cemented in build a tapered dome of concrete around the risers to prevent water from standing around the conduit and causing it to rust at the floor level.

Where possible, install motors with the slack side of belt on top.

Do not install starter and control equipment in line with a belt's travel.

The starting resistance on slip-ring motors should be adjusted so that the motor will start on the first point of the controller.

The motor and control equipment should be provided with a cover wherever there is a possibility of water dripping on it.

Line switches are to be installed so that they will be accessible without a ladder.

All belts, chains and gears should be properly guarded for the safety of the workmen.

As soon as the motor is put into service, make a 24-hr. load test with the recording wattmeter in the circuit.

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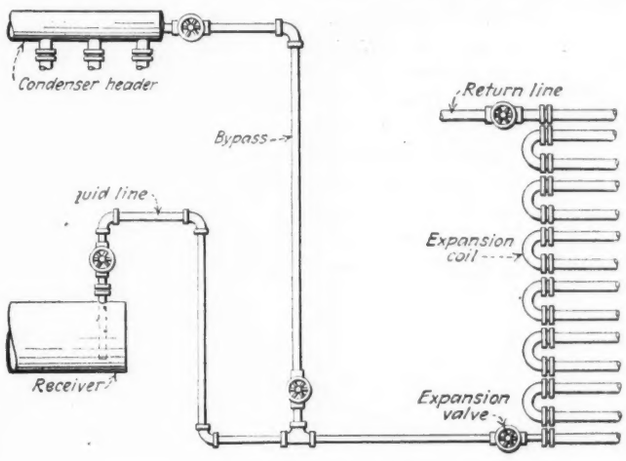
Quick Defrosting of Refrigerator Coils

By D. J. ALLISON

IN AN establishment where perishable food products were handled, heavy accumulations of frost had to be removed from the expansion coils in the cold-storage rooms every few days. To expedite the work and save labor the method of melting the frost away by sending hot ammonia gas through the coils was used. By this means as much as 3,500 sq.ft. of freezing apparatus could be cleared of frost in less than half an hour. The temperature of the storage room would go up perhaps five or six degrees, but the loss would be made up quickly when normal operation was resumed, as the bare surface of the coils would absorb quickly the extra heat.

The device consisted of a 1-in. bypass running from the intake header of the ammonia condenser to the line



Bypass carries hot gas to expansion coil

which connected the liquid receiver with the expansion valves, as indicated in the sketch. To melt the frost from a set of cooling coils it was only necessary to shut off the flow from the receiver, open the expansion valve wide, and open the valve at each end of the bypass. In the meantime the compressor would be run slowly and the flow of cooling water to the condenser partly or wholly stopped, according to weather conditions. This was done to get the gas into the expansion coils at as high a temperature as possible.

All expansion valves other than the one attached to the set of coils under treatment were closed during the operation. The valve in the return line from the treated coil also was kept closed until some of the hot gas had condensed. The return valve then was cracked open a little. Thus the compressor got enough suction gas to keep it cool.

READERS' COMMENTS

Why Air Agitation in Ice Cans?

IN THE July 28 number of *Power* an article discussed the relative purity, from a bacterial view, of ice manufactured by various processes, including nature's.

The article leaves the erroneous impression that ice manufactured from properly treated and filtered raw water and agitated during freezing with clean air is not as pure a product as can be manufactured, except possibly with distilled-water ice.

To take samples of ice, as the author of above article did, manufactured by different processes from different sources of water, in different sections of a city and under different sanitary conditions, and compare their bacterial count, does not prove which method of manufacture is superior in producing a pure product.

It is an undisputed fact that ice manufactured from a water containing bacteria and impurities will be far purer if agitated with clear air during the freezing process—due to the fact that the impurities, including bacteria, are continually being washed away from the ice being formed and eventually can be removed from the core—than ice manufactured from the same source of water without air agitation.

As to the discussion referred to in the July 7 number, it would appear that the author did not thoroughly digest the editorial in question, with which I am in full accord, as it is undoubtedly quite possible to condition the majority of raw waters used in the manufacture of ice, by proper treatment and filtration, to such a degree that pure and wholesome ice can be manufactured therefrom without the aid of agitation. The question arises, in some instances, as to whether the equipment for properly treating and purifying the water would be cheaper than the equipment for agitating. Certainly the former requires more skilled and careful handling, with the additional risk of a larger percentage of impure ice.

Ciudad Juárez, Mexico. H. MILLER.

Fitting Corliss Valves

IN THE Aug. 4 number of *Power* there was a request for information regarding the fitting of corliss engine valves. Perhaps these few hints may prove helpful.

In boring out the valve seats in a corliss engine cylinder it is advisable to start the operation on the side opposite from the valve gear. There are two reasons for this procedure. First, there is always a tendency of the bore of valve seat to be slightly tapered, that is, a trifle smaller on the valve gear side of the cylinder. Second, valves are always fitted and drawn from place for examination from the rear of the cylinder, thus preventing any disturbance of the valve gear.

To machine a valve to fit the seat, assuming that the bore has a slight taper and that the sizes are 5 in. at back side of cylinder and 4.998 in. on valve gear side, set an internal micrometer 0.0015 less than the above sizes, and machine the valve with a taper to fit the seat. If an internal "mike" is not available use the method and formula given on page 330 of "American Machinist Handbook." Take two pieces of hard steel wire and grind and file the ends until they have exactly $\frac{1}{4}$ in. of side play in the bore. This side play, measured in sixteenths of an inch, squared and divided by twice the diameter, gives the difference between the bore and the measuring rod in thousandths of an inch.

Thus $\frac{1}{4}$ in. in sixteenths $= 4$; $(4)^2 \div (5 \times 2) =$ 0.0016 in., a close approach to the internal "mike" measurement. When grinding gaging rods, leave a $\frac{1}{8}$ in. bearing surface on each end of the rod, to assist transferring sizes. After machining the valve, grind into place with oil and flour emery. DONALD RAEBURN.

Glasgow, Scotland.

Designers and Operators Should Cooperate

THE EDITORIAL in the July 21 number for the furtherance of cooperation between the designers and operators of power plants should be received by all with minds open to the many advantages of such close cooperative action.

Much too often are operators left in ignorance, except by their own findings, of the correct operation of equipment put in their charge. Equally as often do designing engineers find a lack of interest by those to whom they leave well-designed and installed equipment. There sometimes exists between the two factions of engineers a maladjustment of mind as to what is expected of the other. The engineer often accepts the idea, without forethought, that the other fellow's thoughts work along the same channels as his and in consequence overlooks going into the details of many of the important subjects. Lack of interest in operation can often be traced to a lack of forethought by the designer or erector; by his considering the operator as one understanding his ideas without further explanation. Operators sometimes think of new equipment as being just another appendage that will show its worthiness or failure without further effort on their part, and interest themselves only as far as their knowledge of it extends.

Another equally important factor in plant operation is a close relationship between the chief engineers and their operators. Too often are the two positions separated by indifference to the other's opinion. The feeling of the one that his judgment is supreme is often met by the idea from those under him of "let it be so," and interest lags. Snap judgment by operators, and in some cases a lack of knowledge, often works against good operation: The duty of operators is to carry on with their best abilities, the ideas that give the best results, but if those ideas are original they should first be subjected to the judgment of their superior. By the same reasoning, ideas concerning changes should be permitted a hearing by the ones who will eventually be affected by them. One chief engineer with whom I have talked said that he never makes any changes in the plant without first getting the opinion of all of his watch engineers. His theory is that they are intimately acquainted with details and consequently their opinions are valuable. He has an admirable plant and operating force.

It furthers interest when the one in charge takes those under him into his confidence. They mean to him, in such instances, more than just workers to do his will. Regular get-together meetings of the engineering personnel is a sure way of gaining confidence on both sides. They should not be too formal; leave the minds free to accomplish the real purposes of the meetings. Discus-

sions, problems and the generalities of operations can be the subjects; the object, a closer relationship between men all working for the same purpose and firmer bonds of fellowship. A blackboard and the free chance to talk and ask questions yields returns that are immeasurable to all. It is human nature with a worth-while man to want to be part of the business. The freedom of an open mind with his superiors of office takes a fellow out of the routine and drudgery. The interchanging of ideas between those responsible and those who carry on has infinite value.

WALLACE WHITLOCK.

New Brunswick, N. J.

Proper Care Will Prevent Anti-Friction Bearing Trouble

THE REPORT on anti-friction bearing lubrication, by the Association of Iron and Steel Electrical Engineers' Committee, June 23d number, brings up a subject of great interest. Anti-friction bearings are such an improvement over sleeve bearings, and are capable of such long periods of operation without requiring attention, that operators and even designers of the machinery have been somewhat lax in giving them a square deal. A large part of the trouble experienced with anti-friction bearings is due to the designer's shortsightedness. In other instances bearings have been abused by those operating the machines. Members of the Association of Iron and Steel Electrical Engineers have apparently had considerable trouble due to bearings losing their lubrication; and from damage to insulation because of oil leakage.

A difference in temperature rise at 44 deg. F. was cited in the report as a result of changing lubricant. Every manufacturer of anti-friction bearings will recommend the type of lubricant to use for different classes of service. There is no hard and fast rule in regard to the lubrication to use, since it will depend upon the load, the speed, the amount of dirt present and the temperature involved. There is no well-defined speed above which oil should be used, or below which grease should be employed, because the lubricant serves the four functions of preventing rust and corrosion, minimizing friction, dissipating heat and forming a supplementary seal between rotating and stationary elements. It may be stated in general, however, that oil is preferable for high speeds and grease for low speeds. Whether the dividing line happens to be 1,500 or 2,000 r.p.m. will depend upon the lubrication method used, and other factors previously mentioned.

Not nearly enough attention is given to the choice of lubricant. After the first change or two, when the lubricant recommended by the manufacturer of the bearing may be used up, new lubricant may be chosen on the basis of cost. The result may be that the cheapest oil is used. The use of animal and vegetable grease is not advisable, because they break down to form free acids or alkalis. Only pure mineral grease or oil should be used, its consistency depending upon the speed, load and temperature. It is important that the lubricant does not absorb moisture, which causes corrosion. Nor should the lubricant contain any solidfying matter, which may tend to clog the bearing, cause unnecessary wear and friction. The lubricant should be free from materials that tend to create a lapping action, which leads to rapid deterioration. Where high speed and temperatures have to be contended with, it is important to employ a grease which will not break up and force the oil from the bearings or form a gummy residue that may clog the rollers or balls and rupture the race.

In regard to loss of lubricant due to leakage or vaporization, adequate seals are available to prevent this. The bearing manufacturer has the choice of cork, felt, leather and various forms of labyrinths. By means of these anti-friction bearings may be made oil-tight during the life of the bearing. Oil seals are frequently omitted, however, because the designer has not left space for a bearing with an oil seal. A bearing with oil seals requires from 30 to 50 per cent more space than those without them. Oil seals are often omitted because they add approximately 15 to 25 per cent to the cost of the bearing. For some classes of service an oil seal will ordinarily pay for itself within a year in lubrication saved, besides preventing damage to equipment. Designers may overook some of the advantages of the oil seal in their effort to keep down the price of their machines. The operating engineer should insist upon oil seals where they are required.

Another cause of trouble with anti-friction bearings is that those who do the installing fail to protect them against grit, dirt and corrosion. Anti-friction bearing manufacturers carefully cover the bearings with oil and seal them before they are put into stock or leave the plant so that they cannot collect dirt nor be attacked by the acid or moisture in the atmosphere. If a bearing is to operate smoothly and silently and have a low coefficient of friction, it is necessary that the surfaces be smooth. It is surprising how rapidly the highly polished surfaces will pit if the bearings are exposed to the atmosphere. Notwithstanding this, spare bearings are often left exposed in plants where the atmosphere is corrosive, without any regard to protection. Frequently the wrappers in which the bearings are shipped are broken or removed. The grease with which the bearing was carefully covered is allowed to be rubbed off so that corrosion and pitting can occur. The result is that the bearing is injured before it goes into service. This is a matter that rests solely with the operating or installation engineer. If those who install and operate anti-friction bearings realized how carefully bearing manufacturers protect their product against corrosion they might also be more careful.

The use of higher motor speeds introduces additional problems for the anti-friction bearing manufacturer. Meanwhile, if everyone responsible for the application, installation and operation of these bearings will bear in mind five simple yet basically important requirements, the majority of anti-friction bearing troubles will disappear. These five requirements, which might be called the "Big 5," are:

1. Choose proper size bearings.
2. Choose proper type bearings.
3. Mount them properly.
4. Lubricate them properly.
5. Maintain them properly.

To these might be added: Keep all spare anti-friction bearings in sealed wrappings adequately protected against dirt, moisture and atmosphere after generously coating them with a rust preventive.

In conclusion it might be well to point out that the use of anti-friction bearings will cut the cost of lubrication at least 80 per cent. It is therefore shortsighted to attempt to reduce the cost of lubrication by using an inferior and unsuitable lubricant.

Chicago, Ill.

ELMER ZITZEWITZ,
Chief Engineer,
Aetna Ball Bearing Mfg. Co.

FROM AMONG READERS' PROBLEMS

Conducted by

L. H. MORRISON

TESTING CONDITION OF METAL IN CYLINDER WALLS—*We are considering the purchase of a second-hand two-stage air compressor and would like to check the condition of the metal between the cylinders and valve passages and the water jackets. How can this be done?* R.J.B.

One of the simplest ways of doing this is to close the valve on the cooling-water line to the cylinder jackets. Then separate the cooling-water discharge connections or, in other words, make separate connections from each head and the cylinder jacket. To each of these connections attach a short length of rubber hose and submerge the other end in a pail of water. When the machine is started a defective casting will be indicated by air bubbling through the water. If any leaks exist they can be located by removing the cylinder head and applying hydrostatic pressure to the jacket.

LOCATING ROCKER SPOOLS—*It became necessary to renew the piston rods of our 6x4x6 duplex boiler-feed pump, and the old rods were sent to the factory as samples. The factory neglected to mark on the new rods the position of the valve rocker spools. How can we determine the correct location of the spools?* M.R.D.

Assuming the old rods are not available, install the new rods in the pump. Next place one of the steam pistons in its mid-position and place the valve rocker shaft in a vertical position. The spool should now be shifted along the new rod until it comes under the rock shaft. Mark this position and drill the rod for the spool dowel pin or locking key. The same procedure may then be followed for the other rod.

WHICH SIDE OF LEATHER BELT TO PULLEY?—*Which side of a leather belt should run on the pulley, the grain or flesh side, and why?* C.R.P.

The strongest part of belt leather is said to be about one-third the way through from the flesh, or rough, side. It is therefore desirable to run the grain or smooth side on the pulley so that the strongest part of the belt may be subject to the least wear. Also, the flesh side is not as likely to crack as the grain side when the belt has been used for considerable time, hence it is better to crimp the grain side rather than stretch it.

EFFECT OF DECREASING ECCENTRIC DIAMETER—*The eccentric on our engine recently ran dry and as a consequence was badly scored, making it necessary to reduce its diameter ¼ in. to obtain a smooth bearing surface. If a new eccentric strap is made to fit the new diameter, how will the operation of the engine be affected?* G.L.L.

In addition to making a new eccentric strap it will be necessary to lengthen the eccentric rod so that the distance from the center of the eccentric to the pin in the end of the rod is the same as it was before reduction in the diameter of the eccentric. With this accomplished there will be no change from the original travel of the eccentric rod pin and the original length of rocker arms and valve rod will give the original valve travel.

METHOD OF RAZING A BRICK CHIMNEY—*We have a 10x150-ft. brick chimney on our property that we wish to raze. What is a practical method of doing this?* M.A.D.

A method that has been used successfully with chimneys of this size is to cut a hole about 4 ft. wide in the outer wall to a height of about 4 ft. from the ground tapering inside to 3 ft. This hole is then packed with timbers, standing vertically, before proceeding further with the excavation. This precaution is necessary to prevent accidental fall of the chimney before the excavating is completed. When the bricks have been cut away on each side to within a foot of the centerline, more packing should be put in, then the cutting continued beyond the centerline a foot or more.

Upon completion of the excavating throw kerosene on the timbers and ignite them. When the timbers have burned out the chimney will come down by its own weight.

PREVIOUS QUESTION DISCUSSED BY READERS

THE QUESTION

WE SHALL shortly place in operation a new turbine that exhausts at 50 lb. pressure to process. Which will be the best practice, and why: to operate the unit against atmospheric back pressure while starting or to bring the unit up to speed while exhausting against the pressure in the process-steam line? F.X.R.

SOME TIME AGO we were confronted with an operating problem apparently identical to that stated in the question.

It is highly probable that the turbine will operate in parallel with another electrical source which will hold it at synchronous speed, and the governing mechanism of the turbine will maintain a constant back pressure. The electrical output will then be governed by the demand for 50-lb. steam.

The diagram shows the arrangement at our plant. Our case is similar to that in the question, but in addition to the exhaust line control. We also bleed at 150 lb. It will be noted that the 150-lb. and 40-lb. reducing valves are set in parallel with the turbine and that relief valves are placed between the turbine and stop check valves, to relieve steam at 160 and 50 lb., as well as the relief valves between the reducing valves and turbine stop-check valves to protect the two process systems when the turbine is down and the reducing valves serve the two processes.

The turbine can be started and brought up to speed while exhausting into the back-pressure system at 50 lb. if there is an appreciable pressure differential between the turbine governor setting pressure and that at which the make-up reducing valve comes into play. In our case, where we maintain a pressure differential of about 2 lb., the exhaust pressure governor prevents the turbine from taking sufficient steam to get up to speed. It will be found best practice, however, to bring the turbine up to speed and parallel it while exhausting freely at as near atmospheric pressure as is possible. The reason will be evident from the following discussion regarding our experience.

Preparatory to starting our turbine, in fact whenever the process lines drop just below 150 lb. and 40 lb., the reducing valves come into operation and hold the pressure up to the predetermined setting. The turbine exhaust and bleed-line auxiliary drain valves are opened to discharge the rapidly formed condensed steam caused by the cold turbine. Auxiliary hand-operated steam valves to relieve the bleed and exhaust lines to the atmosphere are also opened.

The stop-check valves are naturally closed, and held so, by the high differential caused by the process line pressure. The throttle valve is then slowly opened until the turbine first starts, when it is closed partly for a short time, after which it is again opened gradually for a period of about 15 min., by which time the throttle valve is wide open. At this time the governor has come into play and controlled the valves in the steam chest so as to maintain a frequency of 57 cycles, 60 cycles corresponding to 3,600 r.p.m. The governor is then controlled either by hand at the turbine or electrically at the switchboard until the frequency corresponds to the source with which the turbine is paralleled. The unit is then put on the line and the turbine loaded to about 200 kw. for about 5 min., when the auxiliary hand-operated atmospheric relief valve on the exhaust line is gradually closed.

During this time the turbine back pressure gradually builds up to 41 lb., the pressure which causes the exhaust stop-check valve to open, thereby delivering steam to the low-pressure process line and causing the 40-lb. reducing valve to close. When the back pressure attains 41 lb. the governing mechanism to the turbine throttles the 425-lb. steam admission to the steam chest so as to maintain constant back pressure. The electric load at this time will, of course, be dependent on the amount of steam exhausted, and only partly affected by the bleed line, for during this time the bleed mechanism pressure control is set so that a grid valve is "full open" and the turbine performs as a straight back-pressure

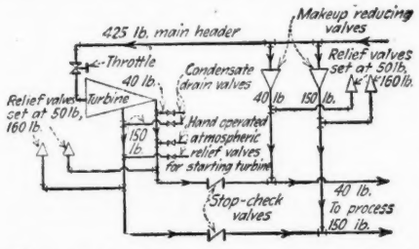


Diagram showing arrangement of exhaust and process piping

machine. (In normal operation the grid valve is used to restrict the flow of steam to the lower pressure stages so as to maintain a constant pressure between it and the first-stage wheels.) After running in this maner for several minutes the bleed pressure control is cut in and then the 150 lb. auxiliary hand-operated atmospheric valve is closed, leaving the turbine fully automatic in its operation.

By such a starting procedure from a cold condition requiring about 30 minutes the turbine is allowed to warm up gradually and it and the controlling mechanisms allowed to "find" themselves. Lower temperatures, and thereby less strains, exist in the lower stages than would prevail if started without using the atmospheric valves. No condensation is allowed to be discharged into the process lines, where we prefer always to have slightly superheated steam.

If started against full back pressure the pressure between the turbine and the exhaust stop-check valve would build up in excess of 40 lb., cause the automatic relief valve to open and then the check valve would open, or both simultaneously, followed by a sudden slamming shut of both valves, repeating the cycle until the steam admission to the turbine was great enough to cause the time of such cycle to approach zero, when continuous flow would be maintained. This is severe duty on large check valves, the possible damage to which could be much more than the cost of steam discharged to atmosphere during the starting period. If the turbine is brought up to speed fast enough there will be fewer cycles passed through; but this likewise will be bad practice, because of the temperature strains set up in the turbine. The last stage is subject to a much lower temperature when started against atmospheric rather than 50 lb. back pressure.

San Francisco, Calif. H. J. BYRNE.

A Question for Our Readers

WE HAVE been greatly troubled with the electric lamps burning out in the hoist room and part way down the incline at our mine. The light circuit is run on knobs and cleats parallel with a 440-volt motor circuit. A 10-kva., 440/220 and 110-volt transformer supplies power to the lights in the hoist room and incline. The total light load is 5,000 watts. The motor circuit supplies an electric hoist driven by a 50-hp., 440-volt induction motor located 300 ft. down in a drift at the head of a 2,000-ft. incline. The 115-volt lamps have been replaced with lamps for 125 volts, but these also burn out. What is causing this trouble and how can it be overcome? R.E.M.

Suitable answers from readers, if received promptly, will be paid for[1] when published.

▼

I THINK the turbine should be operated against atmospheric pressure while bringing it up to speed. This would give the turbine a better opportunity to warm up evenly before load is put on, and it would take less steam during the starting period. After load is put on the turbine it can then be slowly cut in on the 50-lb. back-pressure line.

If the turbine were started against back pressure, process steam would necessarily fill the casing before the spindle was rotated. This would result in uneven and too rapid heating.

Lima, Ohio. JOHN L. WHITE.

THE FACTORS influencing the starting of a back-pressure turbine indicate that it should be started exhausting against atmospheric pressure whenever possible. If a constant pressure is maintained on the process system the piping must be arranged to free the exhaust while starting.

Starting against atmospheric pressure has the advantage of a more thorough and even warming up, with a minimum of leakage around the packing seals and joints. The warming can be done gradually by steam admitted through the throttle and with the rotor turning slowly. If started against high back pressure steam would be admitted through the exhaust into a cold casing and there heat a stationary rotor, which under these conditions is apt to warp due to uneven heating. But gradually increasing the steam flow through the throttle both accelerates the rotor and increases the temperature along it and the casing, slowly bringing both up near the running temperature.

If the turbine load is to be governed by the steam demand, the back-pressure must be built up before the machine is put on the governor, otherwise overloading will result.

GEO. B. LONGSTREET.

Keyport, N. J.

WE HAVE FOUND that starting against high back pressure is the best practice. This is based on the action of our 1,500-kw. turbine exhausting against 55-lb. process pressure. When starting this turbine against atmospheric pressure the steam valves oscillate to a considerable degree, causing surges. When starting against process pressure (55 lb.) there is no sign of oscillation.

Crockett, Calif. C. A. MILLER.

IN THE ANSWER to the question, published in the Aug. 25 number, concerning the time required for a gas or liquid to reach its theoretical velocity in flowing through an orifice, the formula for falling bodies in which t equals time in seconds was incorrectly given as $t = \frac{2^h}{g}$ This should have been $t = \sqrt{\frac{2^h}{g}}$ and the time in seconds to acquire the velocity due to head h becomes $t = \sqrt{\frac{2 \times \text{pressure per sq. in.} \times 144}{32.16 \times \text{wt. per cu.ft.}}}$

[1] As an alternative to cash payment for answers published, readers may select any one of the following books. (Be sure to state the book desired):

Morrison's *American Diesel Engines*; Walker and Crocker's *Piping Handbook*; Norris and Therkelsen's *Heat Power*; Emswiler's *Thermodynamics*; Church's *Steam Turbines*; Uehling's *Heat Loss Analysis*; Croft's *Steam Power Plant Auxiliaries and Accessories*; Powell's *Boiler Feed Water Purification*; Osborne's *Power Plant Lubrication*; Moyer and Fritz' *Refrigeration*; Rietschel-Brabbee's *Heating and Ventilation*; Annett's *Electric Elevators*.

Southwestern Power Conference Well Attended

A fine demonstration of cooperation in which 35 organizations and 1,000 engineers participated. Seven associations held distinctive meetings. During the same week a highly specialized power show featured late equipment for the higher steam pressures and temperatures

SHOWING the way to better cooperation in the power field and to all industry, Kansas City, Mo., is to be complimented on the conception and the holding, from Sept. 7 to 11, inclusive, of a most comprehensive power conference, involving engineering associations, municipal organizations and the mechanical engineering departments of universities and colleges of the Southwest to the number of 35. Seven of the cooperating societies held individual meetings throughout the week. There were joint sessions, luncheons and entertainment in which the entire group participated, and a power and mechanical exposition which had points of interest to all. The total attendance approximated 1,000.

At the opening session of the conference Monday morning some 600 were in attendance. The meeting was held in the Thomas A. Edison Auditorium of the Kansas City Power & Light Company's new building rushed to partial completion to be of service. Albert L. Maillard, general chairman and the active genius responsible for the outstanding success of the conference, presided. Joseph F. Porter, honorary chairman and president of the utility owning the building, welcomed the visiting delegation.

Responses to the welcome were made by representatives of the following participating bodies: for the American Society of Mechanical Engineers, Roy V. Wright, president; American Institute of Electrical Engineers, A. E. Bettis, director; American Society of Heating and Ventilating Engineers, William Russell, vice-president of the Kansas City Chapter; American Society of Civil Engineers, Dean Anson Marston of Iowa State College at Ames, past national president; American Chemical Society, Prof. George Stratton of Kansas University, president of Kansas City section; universities and colleges of the Southwest, Dean G. C. Shaad of the University of Kansas; Engineers Club of Kansas City, E. B. Black, president; National Association of Power Engineers, Charles A. Dobson, national president; Kansas City Safety Council, Sam Ganz, president; state associations of municipal utilities, of Missouri, Iowa, Kansas and Nebraska, James D. Donovan, president of the Kansas association; Southwestern Interstate Coal Operators' Association, William Johnson, commissioner; Kansas City Coal Service Institute, L. D. Kniffin, president; National Electric Light Association, J. F. Owens, president.

Another function in which the entire conference participated was the official opening of the mechanical exposition Monday evening. Addresses of welcome were given by representatives of the city, the Chamber of Commerce, Joseph F. Porter, honorary chairman, and James D. Donovan, president of the Kansas State Association of Municipal Utilities. Responses were made by W. H. Gaylord, Jr., president of the National Exhibitors Association, and by Charles A. Dobson and Lyle A. Pierson, president and vice-president, respectively, of the National Association of Power Engineers. An excellent show had been arranged, with 126 booths displaying the products of 150 manufacturers, and three stages erected at gallery level by the Kansas City Power & Light Company, the Kansas City, Kan., municipal lighting plant, and the Chamber of Commerce. The show was highly specialized, being limited to power plant equipment, and ultra-modern in tone, as it displayed many of the recent specialties that have been developed for high steam pressures and temperatures.

On Wednesday noon at the Kansas City Athletic Club there was a joint luncheon of the conference with the Chamber of Commerce, at which Marshall E. Sampsell spoke on the cooperative effort essential to the proper development of the electrical industry.

A primary event in which all participated was the banquet and dance held Wednesday evening in the Kansas City Athletic Club's ballroom. A feature was the General Electric Company's electronic demonstration on "Adventures in Science," by E. L. Manning.

Of the many sponsors of the conference, seven organizations held distinctive meetings arranged, so far as possible, to avoid conflict. The American Society of Mechanical Engineers held a three-day regional meeting, and the National Association of Power Engineers its forty-ninth annual convention, lasting, as usual, five days. The commercial, engineering and power sections of The National Electric Light Association devoted two days to discussion of pertinent subjects. By the State Association of Municipal Utilities two days were given over to attendance at A.S.M.E. meetings and to a discussion of a paper on "Requirements for Successful Management of Municipal Plants," by R. E. McDonnell. An equal length of time was taken by the Kansas City Coal Service Institute in discussing purchasing, distribution, and the commercial aspects of the industry, and by the Southwestern Interstate Coal Operators' Association to discuss mining, preparation and distribution. On Tuesday evening the Kansas City Safety Council devoted a meeting to safety and to personnel and accidents, which was open to all members of the conference.

Over 1,000 engineers and 35 organizations participated in the Southwestern Power Conference, Sept.

A.S.M.E. Regional Meeting Heads Up Conference

FOR THE first three days of the power conference at Kansas City, Sept. 7, 8 and 9, the American Society of Mechanical Engineers held a regional meeting at which there were six sessions devoted to power, oil and gas power, fuels, petroleum and aëronautics. Registration approximated 400, but included other attendants at the conference.

Edwin Jowett presided over the power session. In the first paper, "Flour Milling and Power Requirements," Grover C. Meyer outlined the four distinct operations involved in the process of producing flour from wheat, explained the functions of the various machines and tabulated the power requirements.

Discussion centered on the heavy power losses from friction in flour-mill drives. Although most modern mills use high-grade equipment for power transmission, including ball bearings, chain drives, etc., the amount of power required to turn the machinery without any product in process is 60 to 70 per cent of the total load. Ultimately it is felt that the solution may be found in direct drives for the rolls and in better lubrication. It was considered significant that little or no change has been made in milling practice in the past fifteen years, and that the Hungarian system of fifty or sixty years ago is still in use.

"High-Pressure Boiler and Turbine Operation at Northeast Station," by J. A. Keeth, of the Kansas City Power & Light Company, was a paper received with much interest. It described the installation and the major problems that came up during two and a half years of operation, mentioning in particular reheater troubles, turbine blade deposits, and the various changes made in boiler-feed water to find the relationship between boiler water concentration and turbine-scale formation. For more complete details see the abstract of this paper in *Power* of Aug. 25, 1931.

The field of high-boiling organic heat-transfer agents has been so enticing that many proposals have been made and a considerable amount of experimental work has been done to determine their applicability. A brief summary of such uses as well as a description of the nature and type of apparatus required was given by John J. Grebe, director of physical research for the Dow Chemical Company of Midland, Mich., in a paper using as a typical example the diphenyl-oxide installation for preheating air at the Bremo station of the Virginia Public Service Company. Any material, liquid air, carbon dioxide, ammonia, water, diphenyl-oxide, or mercury, has its own specific range of temperature within which it is most useful for heat transfer purposes. The fundamental reason for considering the use of diphenyl-oxide, diphenyl, and mixtures of these with naphthalene for heat-transfer purposes is that they permit operation at high temperatures with moderate pressure and that these particular compounds are more stable than others in their boiling range. These compounds are non-corrosive and non-poisonous, so that the equipment required for their use consists of standard steel construction. Except in special cases there is no advantage in using diphenyl-oxide where the maximum temperature required is less than 500 deg. F. Above 750 deg. F. diphenyl-oxide slowly decomposes to form other organic compounds, so that the cost of purification and replacement of the material must be balanced against the advantages derived.

At Bremo the only difficulty encountered was the leakage of diphenyl-oxide through the stuffing boxes on the circulating pump and around valve stems and sight-glass glands. Brief mention was made by the author of the work done by the Dow Chemical Company in connection with the use of diphenyl-oxide in its own power plant for superheating and reheating high-pressure steam. Two types of boiler were recommended for use with diphenyl-oxide.

Dean J. F. Felger of the University of Oklahoma presided at the oil and gas power session. Three papers were presented. V. L. Maleev proposed a method of classifying oil engines as low-, medium-, high-, or super-high-speed, by means of a "speed characteristic" equal to the revolutions per second multiplied by twice the stroke in feet. To show that it provided a consistent and practical means of classifying engines, the author applied it to the data of some 84 engines covering a wide range of sizes, speeds and powers. In his opinion, the method shows in a concise way what has been done by engine builders, and can be used as a guide by designers.

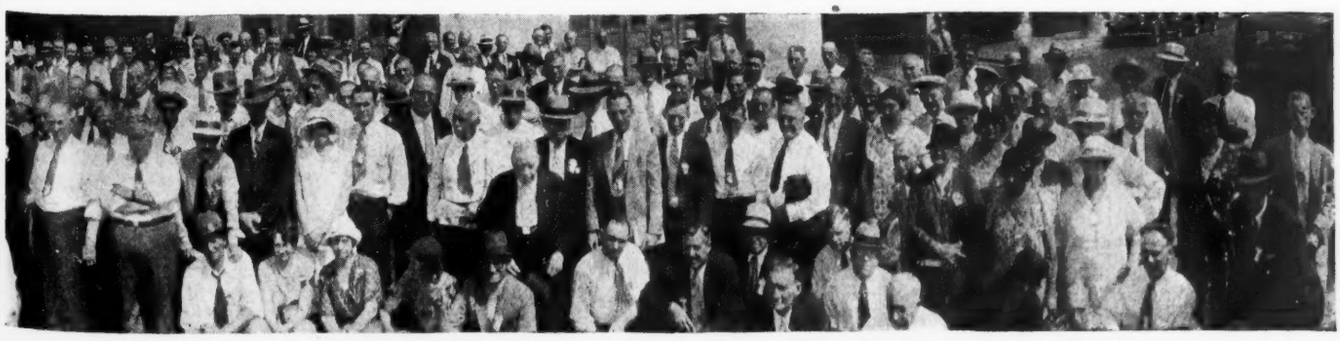
S. A. Hadley, Kansas City district manager for the McIntosh & Seymour Corporation, discussed diesel engines as peak-load units. The author compared the costs of diesel and steam stations of moderate capacity, particularly with reference to peak-load service. Emphasis was placed on the installation of diesel units in peak-load plants in outlying communities rather than in the main central station. The latter then becomes a purely base-load station, with its efficiency greatly improved and the liability of outages decreased.

A paper by H. F. Sheperd of the Cooper-Bessemer Corporation gave attention to internal-combustion engines for the oil and gas industries. Types that have been known for nearly a generation still hold their own in these industries, but operators are demanding refinements in engine and plant design. The diesel is being applied to new uses, such as rotary drilling. Horizontal direct-driven compressors now attain 400 hp. per unit without cooled pistons. Use of refinery byproduct gas has been made more satisfactory by engineers, and gas pipe-line compressor stations have attained great size. For this service twin-tandem, double-acting engines are required. A generation of experience in their use and design has resulted in remarkably reliable engines, with cooling developed to the highest degree.

E. H. Tenney, of the Union Electric Light and Power Company of St. Louis, was presiding officer over the session on fuels. The first paper, by L. Russell Kelce, dealt with improvements that had been made in the mining and preparation of strip coal in the Southwest. Attention was called to the advances that are being made in increased preparation and better quality, and the increasing production of strip coal, notwithstanding the decreasing consumption of coal in the district owing to fuel conservation and the inroads made by other fuels.

Discussion brought out the fact that preparation and care in mining has increased the heat value of strip coal from 9,800 to 10,500 B.t.u. per pound. The competition from natural gas at 15c. per 1,000 cu.ft. and oil at $1 a barrel has taken away an estimated 1,000,000 tons a year from the coal market. Present prices of strip coal have been made possible through modern machinery.

Under the topic "Coal as a Basic Fuel" Henry Kreisinger presented a wealth of tabulated data showing the



to 11. **This picture shows some of the attendants in front of convention hall, Kansas City, Mo.**

original quantity, reduction by mining, and the net reserve of coals in 1928, the distribution of coal among the various states and analyses and comment on typical American coals. The methods of burning it have been well developed, so that it can be used efficiently, and its low cost of production makes it economical. Coal constitutes the bulk of the fuel used, and it is the raw material from which other fuels and many commodities are made. Also included in the paper were analyses of typical fuels, including coal, oil and natural gas; analyses and weights of the products of combustion, and the heat balance, as well as the consumption of gas oil and fuel oil by the various classes of consumer for the years 1926 to 1928, inclusive.

Nature has deposited a wide variety of refractory materials, the most abundant of which are fireclay, silica (ganister ore) and diaspore. Other refractory ores such as chrome, magnesite, bauxite, cyanite and andalusite are seldom used in boiler furnaces. To the list may be added some electric furnace products, the most important of which are silicon, carbide, fused alumina and spinel. Of the available refractory substances, fireclay brick is by far the most universally used in boiler settings. The final paper of the session, by H. Kruson, vice-president of the Mexico Refractories Company, was devoted to some of their most outstanding chemical and physical properties.

W. S. Stueve, of the Oklahoma Gas & Electric Company, conducted the session on petroleum, which contained a paper dealing with recent developments in the liquified petroleum gas industry, the film "Building an Empire" presented by George H. Baird, of the City Service Gas Company, and a round-table discussion on economic pipe-line pumping. The latter discussion centered on the operation of two automatic centrifugal oil-line pumping stations in Oklahoma, one of 75,000 bbl. capacity per day against 750 lb. pressure, the single unit being driven by a 1,600-hp. synchronous motor; the other station, of 40,000 bbl. capacity per day against 800-lb. pressure, uses a 750-hp. induction motor. Both plants are remotely controlled from the main station, fifteen miles distant.

The meeting was closed with a resolution by the mechanical engineers, setting forth the benefits of their participation in the Southwest Power Conference and thanking their Kansas City hosts.

Power Engineers Discontinue Merit System

As a component part of the Southwest Power Conference sharing in joint events, the National Association of Power Engineers held its forty-ninth annual convention in Kansas City, Mo., from Sept. 7 to 11. Headquarters were at the Baltimore Hotel. Business sessions of the convention were held in the Missouri Theater, and the mechanical exposition, augmented by the other participants of the conference, was housed nearby in Convention Hall. Registered attendance at the show approximated 5,000. Official association delegates numbered 244, but the attendance was enhanced considerably by visiting engineers and the local contingent.

Two questions of primary importance occupying the attention of the delegates were the education plan and the finances of the organization as affected by the industrial depression. The merit system has been discontinued and with it goes the position of the educational secretary. In five years over $50,000 had been appropriated to sustain this system, and returns approximating $9,000 seemed to indicate that the majority of a membership averaging over 40 years of age did not appreciate or desire this form of education. All things considered, it seemed best to revert to the original constitutional provision calling for a national educational committee of three, appointed by the president, to devise a suitable plan that will meet the popular demand by centering all effort on the local association rather than on the individual member.

It was freely admitted that all was not well with the official organ of the association, but whatever must be done to bring back its former prestige and earning power was left to the trustees.

In his presidential address, Charles A. Dobson had recommended the foregoing action on the educational plan, and that $3,000 be the budget appropriation for education work. Lisle A. Pierson, national vice-president, reported a loss of 15 per cent in membership. Four new associations have been instituted, eight existing associations have consolidated into two, five associations have been dropped and five more have returned their charters. Secretary Raven's report indicated that nine associations are flag winners, which calls for a gain of 10 per cent or more in membership. Total membership of the association, according to his figures, exceeds 18,000.

Mileage for delegate travel totalled 221,948. At the 3c. per mile voted, this called for an expenditure of $6,658.44. Nearly all of this amount was made available by a check of $6,000 presented by the National Exhibitors Association as the profits accruing from the power show.

Among the constitutional amendments offered for referendum was a proposal suggesting biennial conventions. Financial economy was the chief reason. A number of months will pass before the results of the vote will be known.

During the entire meeting one paper was presented. This consisted of an informal talk by A. L. Maillard, chairman of the conference, on unusual experiences he had had in a number of engineering enterprises. Innumerable questions from the audience indicated the interest taken in this discourse.

A matter worthy of notice was the official recognition given to the valedictory by F. R. Low appearing in the August 25 number of *Power*. The message to the association was read on the convention floor, and in response a resolution introduced by California No. 2 of Los Angeles was ordered spread upon the minutes and a copy of it sent to the honored brother.

Incoming officers of the National Exhibitors' Association for the ensuing year are: President, W. H. Gaylord, Jr., Quigley Company, Inc.; vice-president, John H. Allen, Everlasting Valve Company; treasurer, Fred G. Jolly, Jenkins Bros.; secretary and director of exhibits, F. N. Chapman, A. Leschen & Son Rope Company; executive committee, G. C. Freeman, W. B. Wilson, Robert Jones, J. L. Ehretsman and F. C. Smith.

Officers elected for the N.A.P.E. are: president, Lisle A. Pierson, Detroit; vice-president, Albert F. Thompson, Kansas City; secretary, Fred W. Raven of Philadelphia; treasurer, S. B. Forse, Pittsburgh; trustee for five years, O. Jacobsen, Chicago; conductor, H. L. Wilcox, Newark, N. J.; doorkeeper, P. J. Buller, San Francisco.

Milwaukee has selected as the next convention city, the convention to be held the second week in September.

N.A.P.E. RESOLUTION HONORS F. R. LOW

WHEREAS, *Brother Fred R. Low has been an honored and respected member of this Association for forty-six years, and*

WHEREAS, *his assistance, devotion and untiring interest in the well-being of his brothers is an indelible part of the successful growth of our Association, and*

WHEREAS, *Brother Low has announced his retirement from activity as editor of Power, with intention to enjoy a well-earned leisure; therefore, now*

BE IT RESOLVED, *that the National Association of Power Engineers, in its Forty-ninth Annual Meeting assembled at Kansas City, Mo., hereby acknowledge the gracious sentiments expressed in Brother Low's "Valedictory," and sends to him its greeting, and unanimous desire that he may know of the esteem in which he is held by his brother members of this Association, and of their wish, and hope, that he and his loved ones may long enjoy the freedom so ably won, in reward for a life of devotion to the interest and advancement of his fellows, and*

BE IT FURTHER RESOLVED, *that this resolution be spread upon the minutes of the Association, and a copy of it be sent to Brother Low.*

Respectfully submitted

THOMAS HERLIHY
Past National President
JOHN TOPHAM

ROBERT CRAIG

Gerard Swope Offers Plan to Stabilize Production, Consumption, Employment

Advocates trade associations under federal supervision, stockholder responsibility and unemployment insurance

CONTROL of economic forces through the emancipation of both labor and industry was urged Sept. 16 by Gerard Swope, president of the General Electric Company, at the annual dinner of the National Electrical Manufacturers Association at the Hotel Commodore, New York City. Addressing 600 representatives of the 50 recognized divisions of the electrical industry, Mr. Swope declared that industry must act to forestall legislation threatening the fundamental structure of American business and the cherished ideals of American society.

Discussing "Stabilization of Industry," Mr. Swope pictured industry as shackled with restrictions which prevent control of production, and labor as fettered by disadvantages commonly visualized in "the forty-year dead line."

Universal Basis for Industry

At the outset, Mr. Swope would lift the administration of industry from a parochial to a universal basis. Policies would no longer apply to a single unit but to a given industry as a whole or, indeed, to the entire range of industry. Workers, in the system of guarantees which is set up, would receive uninterrupted benefits no matter in what shop or in what unit of industry they had worked and saved. Thus, their protection would be co-extensive with a lifetime of service rather than being confined to a single job or a single shop as at present.

The breaking down of the barriers which, Mr. Swope said, presently coerce both industry and labor, would be accomplished through trade associations, and would involve the organization of a Federal supervisory body to safeguard the public from exploitation which might accompany the control of production.

Underlying Mr. Swope's proposals are five basic principles, which he enumerated as follows: Regularity and continuity of employment through the stabilization of industry, with unemployment insurance as a reservoir of safety; leadership by organized industry to avoid the lack of uniformity and co-ordination inseparable from direction by the legislatures of the states; standardized forms of reports to stockholders to enable them as owners to be thoroughly and continuously informed as to the progress of their business; co-ordination of production and consumption on a broader and more intelligent basis for the particular benefit of wage earners; promotion of individual initiative and enterprise, and the protection of the public through Federal supervision.

Each industry would establish a trade association to be under the supervision of the Federal Trade Commission, or a bureau of the Department of Commerce, or some Federal supervisory body specially constituted.

These associations would "outline trade practices, business ethics, methods of standard accounting and cost practice"; they would collect and distribute information on volume of business, inventories of merchandise on hand, standardization of products, stabilization of prices, "and all matters which may arise from time to time relating to the growth and development of industry and commerce in order to promote stabilization of employment and give the best service to the public."

Of outstanding importance in the Swope plan is the function of the trade association as the instrument through which industry would exercise control of production. The practices devised and administered by the association in the interest of stabilization would be submitted to the Federal supervisory body, by which their soundness as a social principle would be tested, and to which the public might resort to raise objection.

Such factors as standard accounting and cost systems and standardized forms of balance sheet and earnings statement, quarterly statements to stockholders of business and earnings, and a complete balance sheet and earnings statement annually, would be subjected to uniformity of practice, at least within each individual industry.

Companies of an industrial or commercial character having fifty or more employees and doing an interstate business would come within the plan, to which they would be required to adhere within three years unless the time should be extended by the Federal supervisory body.

Protection of Employees

For the protection of their employees, the participating companies must adopt employee plans providing for workmen's compensation, life and disability insurance, pensions, and unemployment insurance. Characteristic of these plans, and constituting an enlargement of the protective principle, is the absence of forfeiture of benefits, for it is expressly provided that, should a worker transfer from one company to another, or from one branch of industry to another, he would carry with him all of his accumulated gains. To this extent the penalties engendered by advancing years would be eliminated.

If a worker, for some good reason, left his original employer, and went into the service of another concern, he would not thereby forfeit his pension, his insurance, his unemployment insurance contributions, or his status under workmen's compensation. This safeguard, Mr. Swope held, would promote the security of the workers, and materially aid the stabilization of employment.

The pension provision includes contributions by employees to a minimum of one per cent, and approximately equal contributions by the company. The unemployment insurance plan would involve equal contributions by the company and the employee, and payments in times of layoff amounting to 50 per cent of average full-time earnings up to a maximum of $20 per week. The principle of joint participation and joint administration by management and men in these several employee plans is to be followed.

In addition a general board of administration would be formed by each trade association, this board to have nine members representing the trade association, the employees of the member companies, and the public. The general board of administration would constitute a body of overseers. Its duties, as laid down by the proposed plan, would be to interpret the various employee plans, supervise the individual boards of administration of the various companies, form and direct a pension trust for the custody, investment and distribution of pension funds, and in general direct all activities connected with the employee plans.

Advantages of Plan

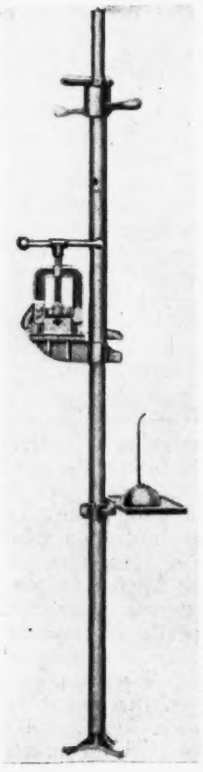
"The foregoing plan," said Mr Swope, "tends to put all domestic corporations of the class described on a parity for domestic business, thereby removing the inequalities of the different laws in the several states, provides for standard forms of financial reports and their periodical issuance for the information of stockholders, and places on organized industry the obligation of co-ordinating production and consumption and of a higher degree of stabilization.

"This will tend to assure more uniform and continuous employment for the worker and the removal of fear from his mind, allowing him to devote himself wholeheartedly to his task. The cost of the product will include these items and will therefore be paid for by the users of the article or service, and not in general by members of the community who are reached by the vicarious methods of the imposition of a tax.

"Then organized industry will be in the position that it should rightly assume of serving the public, with public confidence and with the joint participation of workmen and management in the solution of these vital and far-reaching problems."

WHAT'S NEW IN PLANT EQUIPMENT

Portable Vise Post



TO FACILITATE the cutting and threading of pipe at different locations through the plant the Armstrong Manufacturing Company, Bridgeport, Conn., has introduced a portable vise post designed to be set up rigidly between the floor and ceiling and locked in position. A feather "touch" lock is incorporated which it is claimed cannot become loosened but unlocks with a slight tap.

The post is equipped with a vise stand and tool tray and has a tri-foot self-balancing base designed to prevent shifting, turning and tipping.

Reversing Starter for Small Motors

IN THE NEW across-the-line reversing starter for direct-current and alternating-current polyphase motors up to 3 hp. put out by Cutler-Hammer, Inc., 294 North 12th St., Milwaukee, Wis., reversing is accomplished by two mechanically interlocked magnetic contactors controlled from a remote point by a separate push-button master station.

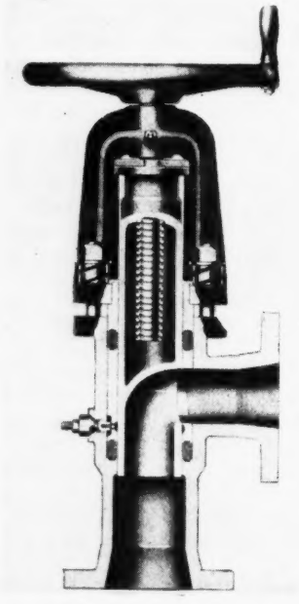
These new starters are designed for use with motors on hoists, lifts and other equipment where a half-time, intermittent-duty reversing starter is required. Over-all size is 7 1/16 in. wide x 8 1/16 in. high x 4 7/16 in. deep. The contactors are a new three-pole design. Silver-to-silver contacts reduce arcing and pitting. The magnet structure consists of a laminated frame with a shading coil for alternating current and a brass shield for direct current.

Two types are available, SRA, arranged for two-wire control only and a maximum capacity of 1 hp., and SRB, for either two- or three-wire remote control.

Starters for intermittent-duty reversing service

Seatless Valve for General Service

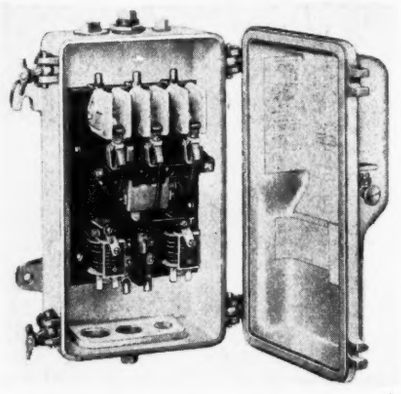
THE IMPORTANT FEATURES of the Yarway seatless boiler blowoff valve manufactured by the Yarnall-Waring Company, Chestnut Hill, Philadelphia, Pa., are embodied in the Type P valve for general service now being produced by that company.



Yarway Type P valve

The valve employs a sliding piston which is said to cut through highly viscous liquids and solids suspended in the solution. By virtue of its design the harder the handwheel is turned after the valve is closed the tigher the valve becomes, as a shoulder on the yoke of the sliding piston contracts with the upper follower gland, forcing it down and compressing the packing rings both above and below the port opening. Springs are provided on the bonnet studs to maintain constant pressure on the packing. When the valve is open it provides a clear unobstructed flow, as will be seen from the illustration. Lubrication of the plunger is effected through a pressure fitting in the body and an annular recess in the plunger.

The valve is made in sizes from 1/4 to 10 in., of various metals, including, iron, steel, stainless steel, acid bronze, aluminum and special metal combinations.



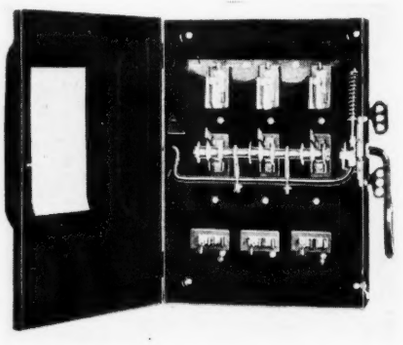
Bulletin 710WT starting switch

Splashproof Starter for Squirrel-Cage Motors

ACROSS-THE-LINE starting switch Bulletin 710WT, for use in industrial plants where a splashproof starter is particularly necessary is announced by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis. The new starter is rated for squirrel-cage motors up to and including 100 hp., 220 volts, and 200 hp., 440-550 volts. On slip-ring motors it serves to control the primary circuit up to and including the maximum rating listed for squirrel-cage motors. If the thermal relay reset button is omitted from the side of the cabinet, the starter is watertight.

Improved Safety Switch

FOUR MAJOR IMPROVEMENTS have been made in the Type A safety switch put out by the Square D Company, 6060 Rivard St., Detroit, Mich. The interlock mechanism of the switch has been simplified, with fewer operating parts, and is more compact, giving ample wiring space on both sides of the switch, as well as at the top and bottom. The



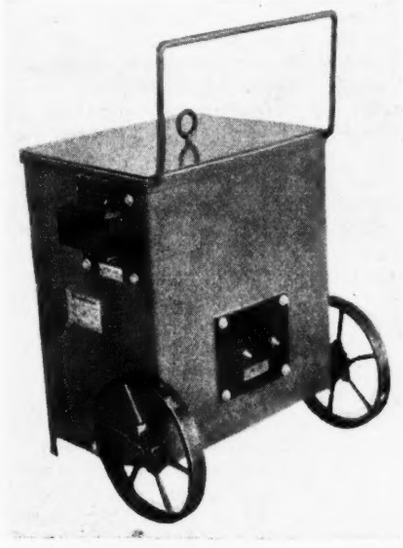
Square D Type A switch

interlock is controlled by a key, and the door can be opened only when the switch is closed through the use of the key.

Positive-pressure fuse clips, made of high conductivity copper with steel spring reinforcements, are now standard in all sizes. This fuse clip grips the fuse firmly under all conditions and insures long contact life, as well as reducing the heating at this point. The dust shields have been made wider, longer and stronger, and a slotted hexagon terminal nut on switches of 100-amp. capacity or less permits the use of a screwdriver, wrench or pliers.

Alternating-Current Arc-Welding Set

AN ALTERNATING-CURRENT arc-welding set designed for operation at between 8.5 and 125 amp. and particularly suited to the welding of thin gage material is being offered by the Westinghouse



Flex-arc 100-amp. welder

Electric & Manufacturing Company, East Pittsburgh, Pa.

Either bare or coated electrodes from $\frac{1}{32}$ in. to $\frac{1}{8}$ in. in diameter may be used, and many of the ferrous alloy materials commonly used with reversed polarity direct current are effectively and easily applied in conjunction with this welder.

The entire equipment, consisting of a special self-cooled transformer, short-wave arc-control system and current-regulating unit, is mounted in a welded steel case.

Differential Limit Controller

THE DIFFERENTIAL or pressure-limit controller illustrated is designed to cut in automatically additional make-up in industrial process plants when the differential falls below a set point and cut it out again when the differential rises again to the normal value. It can also be used for cutting in and out additional meters in measuring systems at

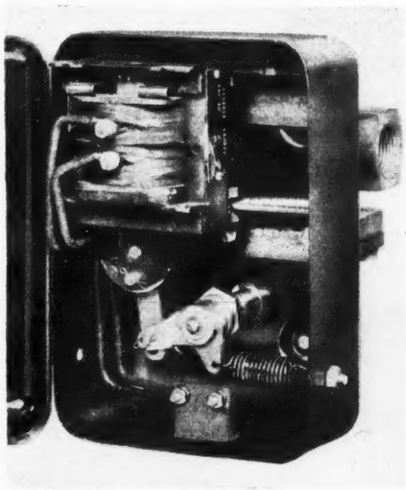
Neilan differential or pressure limit controller

times of varying load conditions, for controlling compressor units, starting and stopping booster pumps, opening and closing valves, etc. The instrument is simple in design and is entirely self-contained. It is manufactured by the Neilan Company, Ltd., 641 Sante Fe Ave., Los Angeles, Calif.

Solenoid-Operated Valve

A NEW solenoid-operated valve for controlling liquids and gases under pressure is a recent product of General Electric Company, Schenectady, N. Y. Some of the many uses for which the new valve is designed are: controlling the flow of brine through cooling pipes in cold-storage rooms, controlling the supply of oil or gas to furnaces, controlling the flow of liquids in connection with weighing machines, and controlling the flow of water in cooling jackets on compressors.

The valve body is made of high-grade castings in two sections, with the upper section fastened to the lower by bolts. The gland connected to the operating mechanism is of the rotary type, which reduces the friction load. The seat and poppet are ground to fit and only materials suitable for liquid or gas that is to be controlled are used. The valves can be made normally open or normally

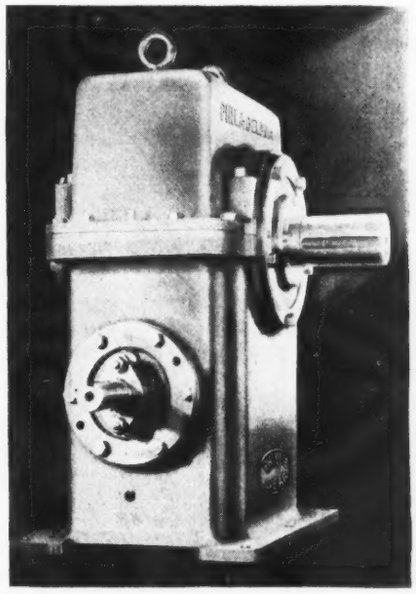


Solenoid-operated valve for controlling flow of liquids

closed, in the field, by drilling the mounting holes in the case and transferring the solenoid and operating mechanisms to the opposite side. The valves are of the unbalanced type and require little power for operation. A standard solenoid is used, and all of the coils are designed for continuous duty. The operating mechanism is so arranged that the solenoid plunger is permitted to accelerate without load for a fraction of the stroke, thereby effecting quick, reliable operation.

Speed Reducer With Rolled Steel Housings

THE SPEED REDUCER units of the Philadelphia Gear Works, Philadelphia, Pa., are now available in welded rolled steel casings, similar in design and over-all dimensions to the cast-iron housing formerly used, but are claimed to be 75 to 100 per cent stronger. The line includes, vertical and horizontal worm-gear, spur-gear, herringbone and spiral bevel gear speed reducers.



Worm-gear reducer with rolled steel housing

"Cee Bee" Cleaning Compounds

HIGHLY concentrated active cleaning compounds are being announced by the Cee-Bee Laboratories Ltd., 655-657 E. Gage Ave., Los Angeles, Calif. These compounds are offered for use for all industrial cleaning problems and are claimed to contain no harmful ingredients. The compounds are strictly physical agents and do not combine with oil, grease or any foreign matter. They clean by deflocculation of solids and the emulsification of liquids and may be applied by hand, by emersion, by pressure gun or through circulation. The compounds are sold in containers holding from 1 to 600 pounds.

NEWS of the FIELD

First Unit of 280,000-Hp. Hydro-Electric Project Nears Completion at Chats Falls

ON THE OTTAWA RIVER 35 miles above Ottawa, Ont., Canada, the Chats Falls hydro-electric development is nearing completion. One of the outstanding features of this project is the dam which extends 18,000 ft. across a number of islands that divide the rapids at this location into several channels. The total length of the concrete structures in the dam is 13,600 ft. Included in this is the power house 627 ft. long, in the left foreground of the figure; a sluice-gate section just to the right of the power house, with four gates 40 ft. wide by 25 ft. high; four stop-log sections, having a total of 72 sluices 18 ft. wide and an aggregate length of 1,725 ft. The remainder of the concrete construction is of solid gravity type 11,000 ft. long, and there is also an earth section of the dam 4,300 ft. long.

The power house, which is about midway between the two ends of the dam is designed for an ultimate capacity of 280,000 hp. In the initial development there will be eight 28,000-hp. 125-r.p.m. propeller-type turbines with space provided to extend the plant for two more units. These wheels will operate under a head of 53 ft., have fixed blades and discharge into elbow-type draft tubes. The generators are rated at 23,500 kva., 3-phase, 25-cycles, 13,200 volts.

The Ottawa River forms the boundary between the provinces of Ontario and Quebec and the development is being made by interests in the two provinces. The Ontario part of the work is sponsored by the Ontario Hydro-Electric Power Commission and in Quebec, the Ottawa Valley Power Company. The plant is so located that four of the units are in Ontario and four in Quebec. When the other two units are installed, the plant will be extended at each end for an additional unit.

Power has been contracted for by the Ontario Hydro-Electric Power Commission and will be stepped up to 220,000 volts through 15,700-kva. single-phase water-cooled transformers for transmission. Morrow & Beatty, Ltd., are the general contractors and the plant will be ready for initial operation early this fall.

1931 Electrical Code Approved by A.S.A.

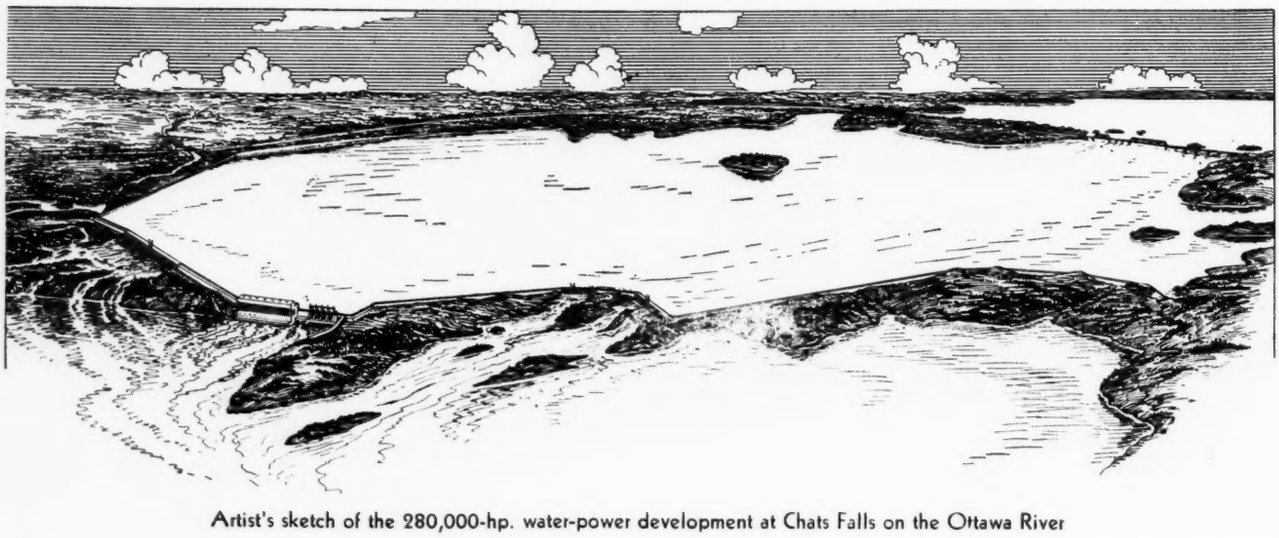
APPROVAL of the 1931 edition of the National Electrical Code by the American Standards Association has just been announced by the Association, following the submittal of the Code by the National Fire Protection Association, sponsor for the sectional committee in charge of the revision of the code under A.S.A. procedure. A first edition of 200,000 copies is being printed by the National Board of Fire Underwriters and copies will shortly be available through the Board's offices in New York, Chicago, and San Francisco, or from the headquarters of the American Standards Association, 29 West Thirty-ninth Street, New York, N. Y.

While in general the majority of the changes in the code are of an editorial nature the more important new material is contained in the following changes:

Changes in Article 4, Service and Service Equipment, permit under special permission buildings having a multiple occupancy to have more than one set of service conductors and in addition approve the use of new forms of multiple conductor service cables. Section 405 of this article contains one of the most important changes in the code which permits the utility meter to be placed ahead of the service switch and the service fuse under certain conditions, and a second change which applies when the first is in effect permits the use with various safeguards, of branch circuit breakers in place of the main service switch.

Changes in Section 508, electrical metallic tubing, accomplished a broader recognition of this new raceway. Two new sections cover wireways and busways and auxiliary gutters. These, together with the existing Section 515, bare busbars and risers, were made necessary by industrial development and the practically universal use of electricity for power purposes.

Many changes were made in Article 8, automatic overload protection of circuits and appliances. These involved a rather complete structural revision of the chapter. Section 808 covering motors and circuits has been materially revised. New subdivisions apply to feeders of motor branch circuits and to secondary circuit conductors for wound-rotor a.c. motors. Recognition of demand or diversity where more than one



Artist's sketch of the 280,000-hp. water-power development at Chats Falls on the Ottawa River

motor is involved is amplified by specific suggestions. Detailed provisions for conductor sizes and automatic overcurrent protection of conductors and motors have been modified.

Article 11, transformers and capacitors, contains a new sub-paragraph to Section 1102 calling for certain nameplate data on this equipment.

An analysis of the 1931 revision of the National Electrical Code compiled by A. L. Abbott and containing in detail all of the differences between the 1930 and the 1931 editions, has been published by the National Electrical Manufacturers Association, 420 Lexington Ave., New York City, as publication No. 31-11, and is for sale by the N.E.M.A. offiice at ten cents per copy.

N. Y. Body Calls Hearings on St. Lawrence Power Contract

PUBLIC HEARINGS will be held by the New York State Power Authority, beginning Oct. 1, for the purpose of obtaining a contract covering the sale, transmission and distribution of the annual 5,000,000,000 kw.-hr. output of the proposed hydro-electric plant on the international rapids section of the St. Lawrence River. Executives, engineers and accountants of power companies will be examined at the hearings concerning the rate phases of the project, and prospective power users, representatives of municipalities and farm organizations will be asked to attend.

Frank P. Walsh, chairman of the power authority, said that preliminary conferences concerning the sale and transmission of the power had been held with the Niagara Hudson Power Company, which controls most of the transmission lines in the northern part of the state. The Niagara Hudson officials, he said, had expressed a desire to cooperate.

British Association to Hold Centenary Meeting This Week

COINCIDING with the Faraday centennial celebrations in England, the centenary meeting of the British Association for the Advancement of Science will be held in London from Sept. 23 to 25. Papers and addresses on engineering and allied subjects will be presented at the meeting, which commemorates the 100th anniversary of the founding of the society.

Sir J. J. Thomson, retiring president of the association, will speak on "The Growth in Opportunities for Education and Research in Physics in the Past Fifty Years." The incoming president, General J. C. Smuts, will deliver a paper on "The Scientific World-Picture of Today." Other papers include: "Prime Movers of 1931, and the Relation Between Steam Engines and Internal-Combustion Engines," Sir Alfred Ewing; "Metals and Alloys in Relation to Engineering Progress," Dr. W. Rosenhain; "The Effect of Temperature on Some of the Physical Properties of Metals," F. C. Lea; "A Symposium on the British Fuel Problem"; "Engineers' Contributions to the Development of Canada," C. H. Mitchell; "Pioneering Work in Electrical Engineering Fifty Years Ago," Dr. Elihu Thomson.

"192-PROOF" COAL BRIQUETS

Operating in Passaic, N. J., under the name of "Anthracite Processing Company," this establishment was so cleverly camouflaged as a coal briquet plant that it took federal agents two years to discover it contained a still with a capacity of 10,000 gal. of 192-proof alcohol a day. The still was concealed in a huge coal hopper, and daily shipments of alcohol were made in coal trucks containing 500-gal. tanks covered by a 3-in. layer of briquets. Enough coal was processed to allay suspicion; only the clogging of sewers due to the disposal of mash led to the discovery of the still

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N. A. P. R. E. Meeting in Houston, Tex., Nov. 10-13

THE 22ND ANNUAL CONVENTION and educational exhibition of the National Association of Practical Refrigerating Engineers will be held in Houston, Tex., on Nov. 10 to 13 inclusive. Headquarters for the convention will be established at the Rice Hotel, while the exhibition and all technical sessions will be held one block away in the Houston Municipal Auditorium. Features of the program include papers and discussions of interest and importance to all groups of the refrigerating industry. The educational exhibition will consist of representative displays of refrigerating machinery and engine-room equipment.

Upstate N. Y. Plant to Use Natural Gas and Water Power

THE FIRST of three generating units is now being installed in what is believed to be only combined natural-gas-fired steam and hydro-electric central station in the world. Owned by the Lamoka Power Corporation, the plant is being erected on Keuka Lake, N. Y., which will supply water for turning the hydraulic turbines and for the steam boilers. Near the lake, 1,750 ft. beneath the surface of the earth, is a strata of gas-bearing sand, with a capacity of 3,000,000 cu.ft. of natural gas a day, which will furnish fuel for the boilers.

In the hydro-electric end of the station, it is planned to install three water-wheel-generators—one of 3,000 hp. capacity, another of 7,500 hp. and a third of 10,000 hp. Pumped storage will be made use of, with water being stored during off-peak hours for use when load demands are the greatest. The pumps will be operated on power supplied by the steam-electric installation. Total construction and equipment will involve an expenditure of $1,000,000.

News of Canada

American approval of two-dam project on St. Lawrence causes comment; Beauharnois progress; natural gas for Saskatchewan

RECENT DESPATCHES from Washington, published in Canadian newspapers, indicating that the Hoover administration is endeavoring to clear the way for an agreement about the St. Lawrence deep waterway project and that United States engineers are ready to agree to the Canadian idea of a two-stage power development, have given rise to much speculation in Canadian political circles and no little surprise is expressed at the alleged change of attitude on the part of the United States engineers. The news is taken to indicate an earnest desire on the part of the Hoover administration to get something started at the earliest possible moment.

As far as the Canadian Government is concerned there is nothing on the records to confirm the despatches from Washington. The Canadian members of the International Board of Engineers dealing with the St. Lawrence have not been advised of any change in the proposals of their United States colleagues. In the meantime, the Canadian minister to Washington is preparing to take up his residence there. He will go equipped with full information on the subject and, presumably, with fairly definite instructions.

A CONFERENCE was held recently in the city of Quebec in which Premier Taschereau and R. O. Sweezey, head of the Beauharnois Power Corporation, discussed various steps in connection with the future of the Beauharnois project. In view of the importance of getting ahead with the work it is understood the Quebec Government will cooperate to the limit as long as the power rights of the province are not interfered with. It is understood that Premier Taschereau as the result of the recent election, which returned him to power with a large working majority, now feels in a stronger position to carry through his policies in connection with this important undertaking. The way is now open to an understanding between the Quebec and Dominion governments and the banking interests which have been providing finances pending the underwriting of a bond issue.

POWER CORPORATION OF CANADA is seeking a franchise to distribute natural gas in Regina, the capital city of Saskatchewan, and would pipe the gas from the Bowdoin field in the State of Montana. The company is also willing to expend a large sum of money in endeavoring to discover supplies of natural gas within the boundaries of the province. The length of the pipe line required to bring the Bowdoin gas to Regina is approximately 175 miles and it is estimated that the expenditure for the whole project including the city distributing system would be close to $8,000,000. Regina has no gas supply of any kind, either natural or artificial, and the Power Corporation proposal, now occupying the attention of the city authorities, is the most recent of a considerable number of natural gas offers submitted to the municipality during the last two years.

COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Nov. 30-Dec. 4. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

American Association of Engineers. Seventeenth annual convention at Huntington, W. Va., Sept., 28-30. Secretary, M. E. McIver, Willoughby Tower, Chicago, Ill.

American Institute of Electrical Engineers. District meeting at Kansas City, Mo., Oct. 22-24. Annual winter convention in New York City, Jan. 25-29, 1932. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Society of Refrigerating Engineers. Joint meeting with the A.S.H.V.E. and annual convention at the Hotel Cleveland, Cleveland, Ohio, Jan. 26-29, 1932. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Refractories Institute. Fall meeting at the Hotel Cleveland, Cleveland, Ohio, Oct. 8-9. Secretary, Dorothy A. Texter, Oliver Building, Pittsburgh, Pa.

National Association Practical Refrigerating Engineers. Annual convention and exhibition at the Municipal Auditorium, Houston, Tex., Nov. 10-13. Secretary, Edward H. Fox, 435 North Waller Ave., Chicago, Ill.

New England Water Works Association. Fiftieth annual convention at the Hotel Statler, Boston, Mass., Sept. 29-Oct. 2. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Obituary

S. E. DICKINSON, superintendent of the municipal light plant at Kendallville, Ind., died recently following a stroke of apoplexy. He was 60 years old, and had been connected with the power plant since 1896, serving first as engineer and later as superintendent.

WALLACE MCCAUSLAND, general manager of sales for the Reading-Pratt & Cady Company, of Bridgeport, Conn., died on Sept. 4, according to an announcement just received from the company.

Personals

A. V. GUILLOU, for the past four and a half years assistant chief engineer of the California Railroad Commission, has resigned to become chief engineer of the newly organized Public Service Commission of Wisconsin. Prior to his connection with the California commission, Mr. Guillou was associated with a number of power companies in that state. He joined the commission in 1920 as an assistant engineer and seven years later became assistant chief engineer.

F. V. LARKIN, professor of mechanical engineering, head of the department and director of the curricula in mechanical and industrial engineering at Lehigh University, has been granted a leave of absence for the current year. He will make a tour of the world with Mrs. Larkin, which will include extensive travel in the Orient and a four months' motor trip in Europe.

W. W. NIELSON, manager of the New Mexico Power Company, was elected president of the Rocky Mountain division of the National Electric Light Association at the recent annual convention in Estes Park, Colo. G. B. BUCK, Public Service Company of Colorado, was elected vice-president along with FRED NORCROSS, Home Gas & Electric Company, and J. G. KEEGAN, Cheyenne Light, Fuel & Power Company, and A. C. CORNELL, Graybar Electric Company, was reelected treasurer. A. H. HEITZLER, Public Service Company of Colorado, was named chairman of the engineering section.

GEORGE H. SCHMUTZ and L. T. BERRY have been transferred from the engineering department of the West Penn Electric Company, a subsidiary of the American Water Works & Electric Company, to another affiliate, the Potomac Edison Company, at Hagerstown, Md. FRED C. LUCAS has been transferred from the power engineering department of West Penn in Pittsburgh to McKeesport, where he will be temporarily engaged in substation maintenance construction work.

JAMES L. STONE, vice-president and general manager of the Spokane Gas & Fuel Company, was elected president of the Pacific Coast Gas Association at its recent annual convention in San Francisco. HARRY L. MASSER, vice-president and executive engineer of the Los Angeles Gas & Electric Company, was elected vice-president, and D. G. MARTIN of San Francisco was made treasurer.

KARL R. MINER, of Yonkers, and MYER JACOBSTEIN, of Rochester, were appointed by Governor Roosevelt on Sept. 14, members of the commission to make a general survey of utility companies in states adjoining the State of New York which are engaged in the terstate transmission of power.

Business Notes

INTERNATIONAL-STACEY CORPORATION, Columbus, Ohio, announces that C. B. Coldwell, who was formerly located in Chicago, has been transferred to the company's office at 1309 Aviation Building, Fort Worth, Tex., where he has been placed in charge of sales of blowers, pumps and gas-plant equipment.

KEASBY & MATTISON COMPANY, Ambler, Pa., announces that its sales organization has been combined with that of the Ambler Shingle & Sheathing Company. All sales are now being handled by Keasby & Mattison through the branch offices of the combined organization in Baltimore, Boston, Chicago, Cincinnati, Cleveland, Detroit, Milwaukee, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis and Washington. The following officers have been elected for Keasby & Mattison Company: Dr. Richard V. Mattison, chairman of the board of directors; A. S. Blagden, president and general manager; W. J. Donahue, vice-president; Royal Mattison, vice-president; U. G. Funk, treasurer; Joe Walker, secretary and assistant treasurer; George F. Stone, sales manager; Ralph E. Frey, manager, building material sales; John L. Shoemaker, manager, magnesia sales; William Jacobsen, manager, fibre sales; Harry W. Tuman, manager, textile sales.

DOW CHEMICAL COMPANY, Midland, Mich., announces susbtantially reduced prices on magnesium metal. The new prices are 30c. per pound in carload lots and 32c. per pound in less than carload lots. The average price of magnesium metal for 1915 as reported by the United States Bureau of Mines was $5 a pound, it is stated, and subsequent reductions since that time have been due mainly to the extensive research program carried on by the company.

BELDEN MANUFACTURING COMPANY, Chicago, Ill., announces the appointment of Russell Koenitzer as sales representative in the Detroit-Cleveland territory. Mr. Koenitzer has been with the Belden company for more than seven years, serving in the production, sales service and advertising divisions.

AMES PUMP COMPANY, New York City, has appointed Himelblau, Agazim & Company, 30 North Dearborn St., Chicago, Ill., as its sales representative for northern Illinois and northern Indiana.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., announces that Earl B. Bremmer, who has been located for thirteen years in the Chicago office—recently as manager of the small motors section, has been appointed manager of appliance electrification with headquarters at East Springfield, Mass.

How's Business?

BUSINESS has had almost as consistently bad breaks from nature and the calendar as it has from statesmen during the past two years, according to *The Business Week*, Sept. 23. Unseasonally hot weather and a late Labor Day have apparently helped make hopes of any pronounced Fall upturn fade as we pass the middle of September with no signs of seasonal stimulation in any important line. Our index continues to slide off to lower levels with steel demand and electric power production stagnant and a steady slackening in freight movement and money turnover as measured by check payments. Building contracts and coal output alone give faint signs of response to seasonal influences.

Production of electricity by public utilities for the week ended Sept. 12, which contained Labor Day, was 1,582,267,000 kw.-hr., compared with 1,635,623,000 kw.-hr. for the previous week, according to N.E.L.A. figures. Production for the first two weeks of September was 4.1 per cent below the corresponding period of 1930.

Trade Catalogs

MOTORS AND GENERATORS—A technical description of the "frog-leg" armature windings used in multi-polar direct-current generators and motors made by the company, is given in Leaflet 2135 recently issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

SEALING COMPOUND—"Helpful Ideas for Engineers" is the title of a little booklet just issued by the Smooth-On Manufacturing Company, 568 Communipaw Ave., Jersey City, N. J., which contains suggestions on the use of "Smooth-On" products and many useful maintenance hints.

INSTRUMENTS—Bulletin No. 174, a general 32-page catalog recently published by the Foxboro Company Foxboro, Mass., covers a complete line of controlling, recording and indicating instruments for temperature, pressure, humidity and flow.

GAS ENGINES—Construction features and applications of slow-speed horizontal two-cycle gas engines are described in two new publications of the Cooper-Bessemer Corporation, Mt. Vernon, Ohio. The first bulletin deals with the Type GA single-cylinder convertible gas or oil engine rated at 25 to 60 hp., while the second bulletin covers the twin-cylinder engine of the same type, rated at 65 to 130 horsepower.

PUMPS—Bulletin G-631, recently published by the Taber Pump Company, 288 Elm St., Buffalo, N. Y., describes and illustrates the construction features and specifications of single-suction centrifugal pumps. Data sheets are included to show many applications.

HEAT EXCHANGERS—Thermal Engineering Company, 701 Spring Arcade Building, Los Angeles, Calif., has just issued three circulars covering heat-exchange apparatus for use in heating and cooling water, steam, gas, oils, gasoline, ammonia and other chemicals.

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Fuel Prices

FUEL OIL

Boston—Sept. 14, tank-car lots, f.o.b. 12@14 deg. Baumé, 2.9c. per gal.; 28@32 deg., 4.85c. per gal.

New York—Sept. 17, f.o.b. Bayonne, N. J., 28@34 deg. Baumé, industrial use, tank-car lots, 3.75c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 4.75c. per gal.

Philadelphia—Sept. 11, No. 3 industrial gas oil, $1.83 per bbl.; No. 4, light industrial fuel oil, $1.31 per bbl.; No. 5, medium industrial fuel oil, $1.20 per bbl.; No. 6, heavy (Bunker C), $1.05 per bbl.

Pittsburgh—Sept. 8, f.o.b. local refinery, fuel oil, 36@40 deg., 2.875c.@3c. per gal.

Cincinnati—Sept. 15, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—Sept. 8, tank-car lots, f.o.b. Oklahoma; freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 22.5c. per bbl.; 22@24 deg., 25c. per bbl.; 24@26 deg., 27.5c. per bbl.; 26@28 deg., 32.5c. per bbl.; 28@30 deg., 37.5c. per bbl.

St. Louis — Sept. 8, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.02 per bbl., or 42 gal.; 26@28 deg., $1.095 per bbl.; 28@30 deg., $1.17 per bbl.; 30@32 deg., $1.22 per bbl.; 32@36 deg., gas oil, 2.901c. per gal.; 38@40 deg., distillate, 3.151c. per gal.

Dallas—Sept. 12, f.o.b. local refinery, 24@26 deg., 70c. per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York.	$1.60@$1.80
Pool 10, h. gr. low-vol.	New York	1.50@ 1.60
Pool 11, low-vol.	New York.	1.35@ 1.45
Smokeless, mine-run	Chicago	1.50@ 1.75
Smokeless, slack	Chicago	.50@ 1.10
Harlan, Ky., slack	Chicago	.75@ 1.00
Franklin, Ill., mine-run	Chicago	2.15
Franklin, Ill., screen	Chicago	1.20@ 1.60
Ind. 5th Vein, m.-r.	Chicago	1.20@ 1.75
Standard Ill., mine-run	St. Louis	1.25@ 1.40
W. Ky., mine-run	Louisville	.85@ 1.25
W. Ky., slack	Louisville	.35@ .60
Pittsburgh, mine-run	Pittsburgh	1.20@ 1.50
Smokeless, mine-run	Cincinnati	1.60@ 2.00
Smokeless, slack	Cincinnati	.50@ .85
Kanawha, mine-run	Cincinnati	1.00@ 1.25
Kanawha, nut-slack	Cincinnati	.60@ .90
Anthracite (Net Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York	$3.25
Barley	New York.	.90@ 1.40

NEW PLANT CONSTRUCTION

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ark., Siloam Springs — City c/o Connelly Harrington, Mayor, postponed indefinitely construction of a municipal light and power plant building, also equipment and distribution system.

Calif., Linden — Linden Irrigation District, plans an election soon to vote $93,000 for pumping plant, pipe line, etc., in connection with proposed irrigation works. E. H. Tibbetts, Alaska Commission Bldg., San Francisco, is engineer.

Calif., San Jose—Santa Clara Valley Water Conservation District, plans an election soon to vote $5,500,000 bonds for the construction of five earth fill dams also installing power plant and three pumping plants in connection with waterworks. F. H. Tibbetts, Alaska Commission Bldg., San Francisco, is engineer.

Calif., Tulare—Central California Ice Co., 702 P. St., Fresno, will soon award contract for the construction of a 60 x 100 ice manufacturing plant and offices at South K and Sonora Sts., here. Estimated cost $45,000. Complete new machinery will be installed. Work will start about Oct. 1.

Calif., Vallejo — Vallejo Electric Light & Power Co., is having plans prepared for the construction of a 1 story, 33 x 55 ft. substation on Kentucky St. W. A. Jones, 403 Alameda St., is engineer.

Colo., Denver—City awarded contract for the construction of a heating plant for new city and county building to McCarty-Johnson Heating & Engineering Co., 1440 Curtis St. Estimated cost $141,000.

Ia., Lenox—City, L. B. Carruthers, Clk., will receive bids until Oct. 6 for the construction of a 38x52 ft. municipal light and power plant to include two Diesel engines, total 500 hp., switchboard and all accessories, also complete distribution system. Estimated cost $65,000 to $85,000.

Kan., Fort Leavenworth—U. S. Army, Capt. L. B. Gerow, Constructing Quartermaster, will soon award contract for the construction of double hangar with annexes and boiler house annex. Estimated cost $83,700. Private plans.

Ky., Louisville—Louisville Gas & Electric Co., 311 West Chestnut St., will build a transformer sub-station at 1710 South 11th St. Estimated cost $250,000. Work will be done by owners forces.

Md., Catonsville—Spring Grove State Hospital, awarded contract for the construction of a power house, coal pocket and railroad switch to C. L. Stockhausen Co., Gay and Water Sts., also alterations to insane building to Thomas Hicks & Son, 106 West Madison St.

Mass., Gloucester—Addison Gilbert Hospital, c/o Phillips & Holloran, 191 Main St., Archts., awarded contract for the construction of a 1 story boiler house on Washington St. to R. E. Runels Construction Co., Lowell.

Mo., Waverly—City defeated $45,000 bond election for a waterworks system including pumping station and equipment, tank on tower and distribution mains, etc.

Neb., North Bend—City will soon award contract for a waterworks system, including well, pump house, turbine pump and motor, mains, etc. Hemmingson Engineering Co., 326-30 Union State Bank Bldg., Omaha, is engineer.

N. J., Hawthorne—Great Atlantic & Pacific Tea Co., 420 Lexington Ave., New York, N. Y., awarded contract for a 125x300 ft. cold storage warehouse, distribution plant, etc., here to Austin Co., 120 Broadway, New York. Estimated cost $250,000.

N. Y., Brooklyn—Reid Ice Cream Co., Waverly and Atlantic Aves., is having revised plans prepared for alterations to plant. Estimated cost $110,000. J. E. Ross, 25 West 43rd St., New York, is engineer.

N. Y., Syracuse—Syracuse Lighting Co., South Warren St., is receiving bids for the construction of a new maintenance shop and service building on Erie Blvd. Estimated cost $500,000.

N. C., High Point—C. S. Grayson, Mayor and City Council, City Hall, will receive bids until Sept. 30 for reconstruction of exterior of Henry Perry pumping station, setting two pumps including interior piping and changing electrical equipment in connection with sewage improvements. William C. Olsen, Inc., Raleigh, are consulting engineers.

Okla., Muskogee—Community Ice & Produce Co., Sulphur Springs, Tex., is having preliminary plans prepared for a 2 story ice and cold storage plant here. Estimated cost $50,000.

Pa., Pottstown—Hill School, W. H. Bell, Trustee, will soon award contract for the construction of a 1 and 2 story, 53x134 ft. power house and laundry. Ballinger Co., 12th and Chestnut Sts., is engineer.

Tex., Edcouch—R. E. Ewing, Santa Rosa, awarded contract for the construction of an ice plant here to C. C. Daniels, Santa Rosa. Estimated cost $80,000.

Ont., Fort Erie—City Council, awarded contract for the construction of a waterworks pumping station and mains on Lake Shore Road to Carroll Sharp Construction Co., 43 Scott St., Toronto. $53,000.

Ont., Toronto—North American Life Assurance Co., 112 King St. W., will soon receive bids for the construction of a 15 story office building including steam heating system, elevators, etc., on King St. Estimated cost $1,500,000. Marani, Lawson & Morris, 38 Bloor St. W., are architects. G. Wallace, 68 Glenwood Ave., is structural engineer and Ewart, Armer & Byam, Excelsior Life Bldg., are mechanical engineers.

Panama — H. Burgess, Governor, Panama Canal, Munitions Bldg., Washington, D. C., awarded contract for the construction of Madden dam, power plant and appurtenant work. Madden dam project near Alhajuela on upper Chagres River here to W. E. Callahan Construction Co., 1220 Arcade Bldg., St. Louis, Mo., and Peterson, Shirley & Gunther, 1441 WOW Bldg., Omaha, Nev. $4,048,657.

Equipment Wanted

Boiler and Stoker—Logan, Utah—Utah State Building Commission, Salt Lake City, will receive bids until Sept. 29 for furnishing and installing boiler and stoker in connection with proposed green houses at State Agricultural College.

Boiler and Stoker Units—Fargo, N. D.—Armour & Co., 316 South La Salle St., Chicago, Ill., will soon receive bids for boiler and stoker units for proposed alterations to packing plant. Estimated cost to exceed $40,000.

Condensers—Wellington, N. Z.—Stores Division, General Post Office, will receive bids until Nov. 10 for supply of 3,500 condensers, 2 mic, 1,150 condensers, 0.5 mic., 1,000 condensers 1 mic. and 2,300 lamp caps.

Electric Equipment—Chicago, Ill.—U. S. Engineers Office, War Dept., Washington, D. C., is receiving bids for electric equipment for Lockport Marseilles and Starved Rock Locks on I. Waterway.

Generating Units, Pumps, Etc.—Petersburg, Ind.—Petersburg Water Filtration Corp., R. W. Dyer, Pres., will receive bids until Oct. 5 for Diesel engine generating units, electrically operated centrifugal pumps, air blower, etc., for proposed waterworks. Estimated cost $80,000.

Generator Unit, Exciter, Etc.—Walnut, Ia.—City will receive bids until Oct. 6 for a 275 to 375 ft. vertical multi-cylinder Diesel engine generator unit, 2 ph. 60 cycle, 2,400 v. direct connected to exciter for proposed municipal light plant improvements.

Hydraulic and Electrical Apparatus—Panama—A. L. Flint, General Purchasing Officer of Panama Canal, Washington, D. C., will receive bids until Oct. 14 for hydraulic and electrical apparatus for Madden dam power plant, Madden dam project here.

Pump—Benson, Minn.—S. A. Berg, City Clk., will receive bids until Sept. 28 for a 500 g.p.m. motor driven turbine pump and accessories.

Pump and Motor—Davis, Calif.—City is receiving bids for a deep well turbine pump complete and 50 hp., 440 v., 3 ph., 60 cycle electric motor for Well No. 3.

Pumping Equipment — Santa Ana, Calif. — Orange County plans to purchase pumping equipment for new well in Westminister Waterworks District.

Sub-Station Equipment—Wellington, N. Z.—New Zealand Government Railways will receive bids until Nov. 17 for supply of complete equipment for three automatic sub-stations.

Switchgears and Transformers—Ottawa, Ont.—Ottawa Hydro Electric Commission, J. E. Brown, Gen. Mgr., 75 Laurier Ave. W., will receive bids until Sept. 25 for one 11,000 and one 2,200 v. switchgears, also until Oct. 23 for three 3,000 kva., 3 ph. oil insulated, self-cooled transformers.

Turbines, Pumps, Generators, Etc. — Grand Valley, Colo.—Bureau of Reclamation, Denver, will receive bids until Oct. 20 for two 2,300 hp. vertical hydraulic turbines, two governors and governor pumps, two 1,875 kva. a.c. generators complete with direct connected exciters and thrust bearings and one power plant switchboard and auxiliary apparatus for Grand Valley power plant, Grand Valley project.

Ventilating Fans and Motors—Boston, Mass.—City Transit Dept., T. F. Sullivan, Chn., will receive bids until Oct. 14 for furnishing and installing ventilating fans and motors for Boston and East Boston ventilating buildings of Traffic tunnel.

Industrial Projects

Ill., Calumet City—D & G. Chemical Co., F. L. Lofgren, Pres., plans reconstruction of plant destroyed by fire. Estimated cost to exceed $100,000. Maturity indefinite.

Mass., Whitman—United Shank & Findings Co., c/o United Shoe Machinery Corp., 140 Federal St., Boston, is receiving bids for addition and alterations to factory here. Estimated cost $40,000. C. W. Hull, c/o owner, is architect.

Mich., Midland—Dow Chemical Co., is having plans prepared for a 1 story rolling mill for magnesium alloy sheets. Estimated cost $50,000. Private plans. Electric motors, heat treating furnaces, straightening mill and fabricating equipment for sheets to 5 ft. in width will be required.

N. J., Maplewood—Kroydon Co., Burnet Ave., will not construct 1 story addition to golf clubs factory. $40,000. D. A. Hopper, 22 Ridgewood Ave., Irvington, Archt. Project abandoned.

O., East Liverpool—C. C. Thompson Pottery Co., awarded contract for a bisque-glost circular kiln, of tunnel type, 60 ft. in diameter to replace upright kilns to Ladd-Cronin Engineering Co., Chicago, Ill. Estimated cost $40,000. New factory unit to house kiln awarded to Potters Lumber Co., East Liverpool.

Pa., Beaver Falls—Mayer China Co., Second Ave. and Fourth St., plans to rebuild power plant and mold shop recently destroyed by fire. $100,000.

Pa., Lansdale—Interstate Hosiery Co., awarded contract for a 3 story, 52x260 ft. hosiery mill to W. F. Lotz, Oxford and Limekiln Pike, Philadelphia. Estimated cost $120,000.

R. I., Bristol—Herreshoff Mfg. Co., 13 Burnside St., c/o E. M. Corbett, 49 Purchase St., Fall River, Mass., Archt., manufacturers of yachts, is receiving bids for a 2 story plant on Hope St. here. Estimated cost $40,000.

Wash., Tacoma—Pittsburgh Plate Glass Co., Grand Bldg., Pittsburgh, Pa., plans to rebuild plant recently destroyed by fire. Loss $75,000.